Fishery Data Series No. 08-53

Migratory Timing and Abundance Estimates of Sockeye Salmon into Upper Cook Inlet, Alaska, 2006

by

Pat Shields

and

Mark Willette

October 2008

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 08-53

MIGRATORY TIMING AND ABUNDANCE ESTIMATES OF SOCKEYE SALMON INTO UPPER COOK INLET, ALASKA, 2006

by
Pat Shields and Mark Willette
Alaska Department of Fish and Game, Division of Commercial Fisheries, Soldotna

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

October 2008

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

Pat Shields and Mark Willette
Alaska Department of Fish and Game, Division of Commercial Fisheries,
43961 Kalifornsky Beach Road, Suite B, Soldotna, AK 99669-8367, USA

This document should be cited as:
Shields, P., and M. Willette. 2008. Migratory timing and abundance estimates of sockeye salmon into Upper Cook Inlet, Alaska, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 08-53, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

Appendix **Page**

ABSTRACT

A test fishery was conducted during the 2006 Upper Cook Inlet (UCI) commercial salmon fishery. The primary objective of the test fishery was to estimate the abundance and timing of the sockeye salmon *Oncorhynchus nerka* run, as measured along a transect near the southern boundary of the UCI management area. The test fishery was conducted from 1 July through 1 August and captured 2,398 sockeye salmon, representing 1,507 catch per unit of effort (CPUE) points. The midpoint of the 2006 run occurred on 24 July, which was 9 days late relative to the historical mean date of 15 July. This represents the latest run-timing since the test fishery began in 1979. A nonlinear mathematical model estimated the 2006 test fish project spanned approximately 69% of the sockeye salmon run. The test fish final passage rate was estimated at approximately 2,659 sockeye salmon per CPUE point. Two formal estimates of the size and timing of the 2006 sockeye salmon run were made during the commercial fishing season, with the first best-fit estimator from each analysis forecasting a total run to UCI of 3.6 and 4.1 million sockeye salmon, respectively. These estimates deviated from the preliminary total run estimate of 5.0 million by 28% and 18%, respectively. The test fish project once again provided valuable data used to aid in critical inseason commercial fishery management decisions.

Key words: Upper Cook Inlet, Alaska, salmon, *Oncorhynchus*, test fishery, migratory behavior.

INTRODUCTION

In 1979 the Alaska Department of Fish and Game (ADF&G) began an Offshore Test Fish (OTF) project near the southern boundary of the Upper Cook Inlet (UCI) salmon management area (Figure 1). The objectives of the project have been to estimate the total run and run-timing of sockeye salmon *Oncorhynchus nerka* returning to UCI during the commercial salmon fishing season. These data have become extremely important to ADF&G management biologists as they help set and adjust commercial fishing times and areas to most efficiently harvest sockeye salmon that are surplus to spawning needs. Moreover, the Alaska Board of Fisheries (BOF) has assembled management plans which require inseason estimates of the size of the sockeye salmon run in order to implement specific provisions of the various plans. The OTF project has increasingly become one of the most important tools fishery managers utilize to make inseason fishery management decisions.

Test fishing results have been reported annually since 1979 (Waltemyer 1983a, b, 1986a, b; Hilsinger and Waltemyer 1987; Hilsinger 1988; Tarbox and Waltemyer 1989; Tarbox 1990–1991, 1994–1999; Tarbox and King 1992; Shields 2000, 2001, 2003; and Shields and Willette 2004, 2005). This report presents the results of the 2006 test-fishing project.

OBJECTIVES

The primary objectives of the project are to:

1. Estimate inseason the total run and run-timing of sockeye salmon *Oncorhynchus nerka* returning to UCI during the commercial salmon fishing season.
2. Present the results of the 2006 test-fishing project.

METHODS

TEST FISHING

Sockeye salmon returning to UCI were sampled by fishing 6 geographically fixed stations between Anchor Point and the Red River Delta (Figure 1). Stations were numbered consecutively from east to west, with station locations (latitude and longitude) determined with global positioning system technology. A chartered test-fishing vessel, *FV Americanus*, sampled all 6 stations (numbered 4, 5, 6, 6.5, 7, and 8) daily, traveling east to west on odd-numbered days and west to east on even-numbered days. Sampling started on 1 July and continued through 1 August. The vessel fished 366 m (1,200 ft or 200 fathoms) of 13 cm (5 1/8 in) multi-filament drift gillnet. The net was 45 meshes deep and constructed of double knot Super Crystal[1] shade number 1, with a filament size of number 53/S6F.

The following physical and chemical readings were taken at the start of each set: air temperature, water temperature (at 1 m below the surface), wind velocity and direction, tide stage, water depth, and water clarity. Air and water temperatures were measured using a YSI salinity/temperature meter. Wind speed was measured in knots and direction was recorded as 0 (no wind), 1 (north), 2 (northeast), 3 (east), 4 (southeast), 5 (south), 6 (southwest), 7 (west), or 8 (northwest). Tide stage was classified as 1 (high slack), 2 (low slack), 3 (flooding), or 4 (ebbing) by observing the movement of the vessel while drifting with the gill net. Water depth was measured in fathoms (fm) using a Simrad echo sounder, and water clarity was measured in meters (m) using a 17.5 cm secchi disk.

All salmon captured in the drift gillnet were enumerated and identified to species and sex. Sockeye salmon ($n \leq 30$ at each station) were measured for fork length (mideye to tail fork) to the nearest mm and also had a scale removed (for age determination) as described by Koo (1955). Scales were mounted on gum cards and impressions made in cellulose acetate, as described by Clutter and Whitesel (1956). The age of each fish was determined after examining scales with a microfiche viewer under 40x magnification. Ages were reported in European notation (Koo 1962) and followed criteria established by Mosher (1969) and Tobias et al. (1994).

The number of fish caught at each station (*s*) on each day (*i*) was expressed as a catch per unit of effort (CPUE) statistic, or index, and standardized to the number of fish caught in 100 fathoms of gear in one hour of fishing time.

$$CPUE_{s,i} = \frac{100\,fm \;\cdot\; 60\,\text{min} \;\cdot\; number\ of\ fish}{fm\ of\ gear \;\cdot\; MFT} \tag{1}$$

where:

MFT = mean fishing time.

Mean fishing time (MFT) was calculated as:

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

$$MFT = (C - B) + \frac{(B - A) + (D - C)}{2} \tag{2}$$

where:

A	=	time net deployment started,
B	=	time net fully deployed,
C	=	time net retrieval started, and
D	=	time net fully retrieved.

Once deployed at a station, the drift gillnet was fished 30 minutes before retrieval started. However, the net was capable of capturing fish prior to being fully deployed, and during the time it was being retrieved. MFT was therefore adjusted by summing the total time it took to set and retrieve the net, then dividing this time in half, and adding it to the time when the entire net was deployed and fished.

Daily $CPUE_i$ data were summed for all m stations (typically 6) as follows:

$$CPUE_i = \sum_{s=1}^{m} CPUE_{s,i} \tag{3}$$

Cumulative $CPUE_i$ ($CCPUE_d$) was given by:

$$CCPUE_d = \sum_{i=1}^{d} CPUE_i \tag{4}$$

where:

d = day for which estimate is being made.

DESCRIBING THE SALMON MIGRATION AND PROJECTING TOTAL RUN

The run entry pattern was described for each of the previous years based on the respective test fishing data as per Mundy (1979):

$$Y_{yr,d} = 1 / (1 + e^{-(a + bd)}) \tag{5}$$

where:

$Y_{yr,d}$	=	modeled cumulative proportion of $CCPUE_{yr,f}$ (f = final day of season) for year yr as of day d, and
a and b	=	model parameters.

Variables without the subscript *yr* indicating year refer to the current year's estimate. To determine which of the previous run-timing models most closely fit the current year's data and to estimate total run for the entire season (TR_f), a projection of the current year's $CCPUE_d$ at the end of the season ($CCPUE_f$) was estimated as per Waltemyer (1983a):

$$CCPUE_f = \frac{\sum_{i=0}^{d} CCPUE_d{}^2}{\sum_{i=0}^{d} Y_{yr,d} \cdot CCPUE_d} \tag{6}$$

This model assumes that the average day of return and its variance for previous year *yr* is the same for the current season (Mundy 1979). To test this assumption, inseason Y_d was estimated as:

$$Y_d = \frac{CCPUE_d}{CCPUE_f} \tag{7}$$

and mean squared error (*MSE*) between Y_d and $Y_{yr,d}$ was estimated as:

$$MSE = \frac{\sum_{i=0}^{d} \left(Y_{yr,d} - Y_d\right)^2}{d+1} \tag{8}$$

Years were ranked from lowest *MSE* (best model) to highest (worst), and the best fit years were used to estimate $CCPUE_f$. Catchability, or the fraction of the available population taken by a defined unit of fishing effort, was estimated as:

$$q_d = \frac{CCPUE_d}{r_d} \tag{9}$$

where:

q_d = estimated cumulative catchability as of day *d*, and

r_d = cumulative total run as of day *d*.

The cumulative total run on day *d* was estimated from the sum of all commercial, recreational, and personal use harvests to date, the estimated total escapement to date, and an estimate of the number of sockeye salmon residual in the district at that time. Commercial harvest data is estimated inseason from catch reports called or faxed into the ADF&G office. All commercially harvested salmon in UCI, whether sold or kept for personal use, are required to be reported to the Soldotna ADF&G office by fishermen or the processors they sell their fish to within 12 hours of the close of a fishing period. For a complete list of reporting requirements, please see the following statute: AS 16.05.690(a) and regulation: 5 AAC 39.130 Reports required of processors, buyers, fisherman, and operators of certain commercial fishing vessels; transporting requirements. Recreational harvest data was estimated inseason and provided by Division of

Sport Fish staff. Personal use harvests were also estimated inseason from daily reports from the various fisheries in combination with an assessment of previous year's personal use catches from runs of similar abundance. Total escapement to date included estimated escapements into all monitored systems (Crescent, Susitna, Kenai and Kasilof Rivers, and Fish Creek) and unmonitored systems, which are assumed to be 15% of the escapement into monitored systems (Tobias and Willette 2003). The number of fish residual in the district was estimated by assuming exploitation rates of 70% in set net fisheries, 40% in district-wide drift net fisheries, and 25% in reduced district drift net fisheries (Mundy et al. 1993). For example, if the drift gillnet fleet harvested 500,000 sockeye salmon on an inlet wide fishing period, the number of sockeye salmon originally in the district would have been estimated at 1,250 (500/0.40 = 1,250) and the number remaining, or the residual, would have been estimated at 750,000 (1,250 – 500 = 750).

Passage rate, the expansion factor used to convert CPUE into estimated numbers of salmon passing the test fishing transect, was calculated as:

$$PR_d = 1/q_d \tag{10}$$

Total run at the end of the season (TR_f) was then estimated from

$$TR = PR \cdot CCPUE_f \tag{11}$$

To calculate the midpoint of the run, which is the day on which approximately 50% of the total run had passed the OTF transect, the following formula was used:

$$M = a/b \tag{12}$$

where:

M = mean date of run, and

a and b = model parameters.

Because the test fishery did not encompass the entire sockeye salmon run, the total $CCPUE_f$ for the test fishery was estimated after the season using the following 2 methods:

$$CCPUE_f^h = CCPUE_f \cdot \frac{H_t}{H_L} \tag{13}$$

where:

CCPUE_f^h = total estimated $CCPUE_f$ for the season, based on harvest,

H_t = Total commercial harvest for the season,

H_L = total commercial harvest through final day of test fishery (f+2), and

L = number of days (lag time) it took salmon to travel from test fishery to commercial harvest areas (2 days).

$$CCPUE_t^r = CCPUE_f \cdot \frac{E_t + H_t}{\sum_{S=1}^{6} E_L + H_L} \tag{14}$$

where:

$CCPUE_t^r$ = total estimated $CCPUE_f$ for the season, based upon total run,

E_t = total escapement for the season,

H_t = total commercial harvest for the season,

E_L = total Upper Cook Inlet escapement through final day of test fishery,

H_L = total Upper Cook Inlet commercial harvest through final day of test fishery, and

L = number of days (lag time) it took salmon to travel from test fishery to spawning streams or to be available for commercial harvest.

The total run adjustment to $CCPUE_f$ (Equation 14) has replaced adjustments based on harvest alone (Equation 9) primarily due to modifications to commercial fishing management plans made by the BOF. Current management plans allow for much less fishing in August than in the past; therefore, adjustments based on harvest alone would not have accurately reflected the additional fish that entered the district after the test fishery ceased. The total run to date on the last day of the test fishery was computed by summing all commercial harvest data and estimates of escapement from the 4 sockeye salmon sonar enumeration sites, one weir site, and an estimate of escapement to all unmonitored systems through day *d*. An estimate of sockeye salmon escapement to all non-monitored systems in UCI is considered to be 15% of the monitored runs. Lag times are the approximate time needed for fish to migrate from the test fish transect to a destination. As suggested by Mundy et al. (1993), lag times must be accounted for when estimating the total run passing the test fish transect on day *d*. A lag time of up to 2 days was assumed for fish harvested in the commercial fishery. The following lag times were assumed for fish entering the escapement: Crescent River, 1 day; Kasilof and Kenai Rivers, 2 days; and Yentna River and Fish Creek, 7 days (15% of these totals are allocated to unmonitored systems) (Mundy et al. 1993). The number of sockeye salmon harvested in sport and personal use fisheries after test fishing ceased that are not already accounted for in escapement monitoring are assumed to be insignificant and therefore are not utilized in the $CCPUE_f$ post test fishery adjustment.

Adjusted estimates of $CCPUE_f$ ($CCPUE_t^h$ and $CCPUE_t^r$) were used for postseason estimates of TR_f.

RESULTS AND DISCUSSION

A total of 2,398 sockeye salmon were captured during the 2006 test fishery, as well as 1,023 pink salmon *O. gorbuscha*, 988 chum salmon *O. keta*, 1,613 coho salmon *O. kisutch*, and 12 Chinook salmon *O. tshawytscha* (Tables 1–2, Appendices A1–A12). It should be noted, however, that these numbers include estimates of the number of fish caught on days when the test boat could not fish due to rough seas. In 2006, the test boat was unable to fish 29 stations from 8 different days, which represents the most stations missed since the program began in 1979. Catch data for these days was interpolated by averaging catches from the day before and the day after for each station that was not fished. Sockeye salmon daily cumulative catches ranged from 3 to 278 fish (Table 1). The unadjusted total sockeye salmon $CCPUE_f$ for the 2006 project was 1,507, with daily CPUE values ranging from 2 to 150. The $CCPUE_f$ of 1,507 represented the third lowest unadjusted $CPUE_f$ in the OTF program since 1992, which is when the number of stations sampled by the test fish boat was standardized to the current 6 still being fished (Tarbox 1994). Since that time, the relationship between the annual test fish unadjusted $CCPUE_f$ and the total annual run of sockeye salmon to UCI has been significantly correlated ($P < 0.05$), but the fit of the data ($R^2 = 0.30$) is not strong enough to utilize test fish $CCPUE_f$ alone to predict the total annual run (Figure 2). Moreover, the autocorrelation and partial autocorrelation functions of the regression residuals indicated no significant ($P < 0.05$) correlations at lags up to 5 years. However, the annual $CCPUE_f$ statistic is reliable enough to provide a rough estimate of annual run strength, as the regression formula averaged about 25% error in predicting the size of the annual run from the true value.

The distribution of sockeye salmon catches along the test fish transect was similar to the distribution of CPUE values (Tables 2 and 3), which would be expected when fishing occurs at fixed intervals at each station.

Tarbox and Waltemeyer (1989) provided further detail into some of the assumptions the curve fitting procedures utilized to estimate the total CPUE statistic during the season. One of the major assumptions is that 24 June represents the first day of the sockeye salmon run to UCI. Variability in actual runs can therefore result in an average or early run being misclassified as late, especially during the first couple weeks of the test fish program. For this reason, 20 July was chosen as the earliest date that formal estimates of each year's total run size are made. By this time in the run, there are enough data points in the current year's run-timing curve to provide a more accurate estimate of what the total CPUE will be at the end of the season. In addition, Tarbox and King (1992) and later OTF annual reports all suggested that the initial first best fit estimate made around mid July was not always the most accurate, i.e., the second or third best fit estimate should carefully be considered. Therefore, the method now used to make the first formal inseason estimate of the total run includes an examination of the top 5 or 6 best fits. Careful consideration is given to those years whose fits reveal the least day to day change in predicting what the final test fish CPUE will be. These years are identified as being potentially better fits, especially if the mean sum of squares statistic is also improving. Sockeye salmon run-timing from other areas of the state are also considered to see if a consistent pattern exists. Until more years of data are collected from various runs, caution is advised when choosing the top fits to make projections of the final test fish CPUE, especially prior to 20 July.

The first formal estimate of the 2006 UCI sockeye salmon run was made on 25 July, using commercial harvest and test fishery data through 24 July (Table 4). Up to that point in the season, the sockeye salmon run had progressed in a somewhat atypical fashion. For example, the Susitna River run was very weak, as expected, while the Kenai River run, which was also expected to be weak, turned out to also be very late in run-timing. Conversely, the Kasilof River sockeye salmon run was one of the strongest on record. All of these circumstances resulted in multiple closures to drift fishing in the Central District and to the set gillnet fishery in the Northern District. In order to target commercial harvest as much as possible on Kasilof River sockeye salmon stocks, the Kasilof River Special Harvest Area (terminal fishery) was used extensively. Unfortunately, when the drift gillnet fishery does not fish inlet wide periods, this makes estimating the residual number of fish in the district very difficult. Nevertheless, the 2006 test fish *CCPUE* curve was mathematically compared (mean sum of squares statistic) to runs from 1979 through 2005, with fits of the data ranked from best to worst. Based on an estimate of the run to date of 2.30 million sockeye salmon through 24 July (this estimate included the number of fish residual in the district), a passage rate of 2,370 was calculated. The best fit of the current year's *CCPUE* curve tracked the 1994 run, which was a 4-day late run, and projected that 3.60 million fish would return to UCI in 2006. As cautioned earlier, the first best fit using data from approximately 20 July often turns out not to be the best fit by year's end, so the top 5 best fits were considered, which included runs from 1991, 2004, 2005, and 1987. From these data, a total run estimate of 2.84 to 3.84 million fish was made. The top 5 best fits all tracked runs that were late (2 to 6 days) relative to the 15 July mean date of entry at the test fish transect line.

UCI commercial fishery management plans compel ADF&G to make an inseason estimate of the number of sockeye salmon in each year's run that are of Kenai River origin. Various management actions in both sport and commercial fisheries are tied to the total abundance of Kenai River sockeye salmon, which is characterized by 3 different ranges: less than 2 million fish, between 2 and 4 million fish, and greater than 4 million fish (Shields 2006). Using the top 5 best fits of previous year's runs to the current year's *CCPUE* curve through 24 July, the estimated total 2006 Kenai River sockeye salmon run was projected to be between 0.99 and 1.49 million fish (Table 5). With 0.53 million Kenai River sockeye salmon estimated in the run to date, this meant that 0.46 to 0.96 million fish remained in the run. The total run projection was somewhat lower than the preseason forecast for the total Kenai River sockeye salmon run of 1.85 million fish.

The next formal estimate of the total run of sockeye salmon to UCI in 2006 was made following the 31 July fishing period (Table 4). The run to date was now estimated at 3.45 million fish, with a *CCPUE* of 1,286. The passage rate was consequently estimated at 2,681 fish per CPUE point. The best fit still tracked the 1994 run, which projected a $CCPUE_f$ of 1,547 and a total run of 4.1 million fish. The top 5 best fits all tracked late runs and projected a total run to UCI of 3.4 to 4.4 million fish. The actual total run estimate of sockeye salmon to UCI in 2006 was 4.97 million fish, which includes commercial, sport, and personal use harvests, as well as escapement to all systems. Therefore, the first best fit run estimates from the 2 formal inseason forecasts of the 2006 run were approximately 28% and 16% lower than the actual run size, respectively. The total Kenai River sockeye salmon run was now projected to range between 1.52 and 2.19 million fish (Table 5), estimates which bracketed the preseason forecasted run to this system. Approximately 1.42 million Kenai River sockeye salmon had already been accounted for, therefore, as many as 770,000 fish were left in the 2006 run. This estimate alerted ADF&G staff to the possibility that the 2006 Kenai River sockeye salmon run could exceed 2.0 million fish. If that occurred, a different set of management plan provisions would go into effect. And, by 7 August, the Kenai River sockeye salmon run was indeed projected to exceed 2.0 million fish. By that date, 1.68 million Kenai River sockeye salmon had been accounted for. In reality, the final Kenai River run for 2006 eventually reached 2.5 million fish.

Figure 4 depicts the OTF error in projecting the total sockeye salmon run based on the best fit of the data on or soon after 20 July. As can be seen in this figure, the error in the 20 July estimate has been significant (>30%) only on runs that were 2 or more days early. Prior to 2006, for runs that were 1-day early, on time, or late, the OTF error in predicting the annual total run ranged from -6.4% to +17.6% (average = +5.3%) of the actual run. Conversely, for runs that enter the district 2 or more days earlier than average, the OTF curve-fitting estimator did not perform nearly as well, with a range in error of +8.8% to +75.4%, or an average of +36.5%. This year, the OTF curve-fitting estimator projected a total run that was 28% less than the actual run, which was the largest error ever seen for runs that were 1-day early, on time, or late. However, because this year's run was a record late run (9 days late), it is understandable that the OTF curve fitting procedure would under estimate the actual run. For much of July, commercial, sport, and personal use fisheries targeting Kenai River sockeye salmon stocks were closed or restricted. In fact, 57% of the Kenai River sockeye salmon escapement of 1.5 million fish was counted in August (Shields 2007). Allowing for a 2-day lag for fish to be counted in escapement in the Kenai River (Mundy et al 1993) after the test fish program ends, more than 47% of the Kenai River escapement occurred after the OTF project ended.

The last day of test fishing typically occurs on 30 July each year, which means the "tail-end" of the sockeye salmon run is not assessed by the project. In 2006, the test boat fished on 31 July and 1 August because it was unable to fish on either 29 July or 30 July. Two methods were developed to estimate the percentage of the run that occurs after the test fishery ceased so that postseason adjustments could be made to the *CCPUE* statistic to reflect what it would have been had the project continued through the end of the sockeye salmon run. The first method accounts for the number of fish harvested commercially after the test fishery ends (Equation 13), while the second method enumerates both escapement and commercial catch (total run) after the test fishery terminates (Equation 14). The sport and personal use harvest of sockeye salmon that occurs after the test fishery concludes is assumed to be minimal and therefore is not considered. Table 6 shows the differences in the annual $CCPUE_f$ statistic after postseason adjustments were made using either the harvest or total run method. Although the changes are relatively minor, they do have an effect on the algorithms that are used to fit the current year's *CCPUE* to run-timing curves from previous years, because the a and b coefficients in the equation describing the historical run timings are changed. Beginning in 2002, the total run method was used to make postseason adjustments to all previous years' *CCPUE* statistics (Shields 2003). For the 2006 season, the final test fish *CCPUE* of 1,507 was adjusted to 1,969; in other words, approximately 31% of the total sockeye salmon run occurred after the test fishery ceased.

A nonlinear mathematical model (Mundy 1979) was fit to the *CCPUE* proportions of the sockeye salmon run to UCI. Using the total run-adjusted *CCPUE*, this analysis suggested that 4.6% of the run had passed the transect prior to the start of test fishing on 1 July and that the run was 73.4% complete at project termination on 1 Aug (Figure 3 and Appendix A13). Therefore, the mathematical model indicated that test fishing covered only 69% of the run. The midpoint date of the 2006 UCI sockeye salmon run (the day on which approximately 50% of the total run has entered UCI at the test fish transect) occurred on day 31.2, or 24 July, which was 9 days late relative to the historic average mean date of 15 July (Table 7). This entry timing represents the latest run that had ever been observed since the test fish project began in 1979, and was 3 days later than the 2005 run, which had set the record for the latest run to UCI. Moreover, in 2006, approximately 57% of the sockeye salmon passage into the Kenai River occurred in August, which is the largest percentage of escapement in August since escapement monitoring began in 1978 (Shields 2007).

Surface water temperatures measured along the test fish transect ranged from 6.8°C to 13.2°C and averaged 10.3°C for the year (Appendices A14 and A15). The average water temperature was very close to the average from the previous 9 years of 10.6°. Because the 2006 run of sockeye salmon was the latest ever observed in UCI, and water temperatures are believed to play a significant role in the timing of salmon runs, these data are often closely monitored. However, water temperature data alone may or may not be an accurate predictive tool for gauging the run-timing of UCI salmon stocks. For example, the 2005 UCI sockeye salmon run was the latest run ever observed at that time in UCI, yet surface water temperatures along the test fish transect were the warmest ever measured. Warmer water temperatures are often correlated with early returns of salmon. For example, Burgner (1980) showed that the arrival dates of Bristol Bay sockeye salmon were early during years where water temperatures were warmer than average. Therefore, considering the fact that surface water temperatures at the test fish transect in 2005 were warmer than average, it could have been expected that the sockeye salmon run would have been early in run-timing. But, the 2006 run, which had a run timing 3 days later than the 2005 run, would not have been expected to be a 9 day late run based solely on water temperature data. It would seem then that factors other that water temperature may play a role in determining salmon run timing in UCI. In the third volume of a series of books dealing with Fishery Oceanography, Pearcy (1992) summarized some of the factors that affect the coastal migration of returning adult salmon. He reviewed the orientation mechanisms used by salmon in coastal waters and concluded that prior to entering estuaries adult salmon probably rely on cues that are different from those used in the open ocean phases of their migration. Salinity, temperature, currents, and bathymetry were all thought to play a role in migration. Another dynamic to consider that could affect run timing is the age composition of the run, which relates to fish size; larger fish swim faster than smaller fish (Flynn and Hilborn 2004). Therefore, it is likely that a combination of factors affects fish migration and run timing. In fact, in an attempt to better understand and predict sockeye salmon migrations into UCI, ADF&G conducted a companion study on board the test fish vessel in 2002–2005. Using side-scan sonar, fish distribution in the water column was measured in relation to various oceanographic data, such as water temperature, salinity, tide stage, and water clarity. These data have not been published yet, but one of the objectives of the study was to determine whether or not the OTF inseason run forecasting model could be improved using this additional information.

Air temperatures along the test fish transect ranged from 7° to 15°C and averaged 11.3°C, with station averages nearly identical to the previous 10-year averages (Appendices A14 and A15). Wind velocities averaged 7.2 knots for the month, which represents the second calmest conditions observed during the past 10 years. Wind direction was variable, but in general winds originated out of the south to southeast. Salinity and secchi disk readings were very close to the averages from all previous years (Appendix A16).

Appendix A15 provides a summary of the physical data that has been collected at each of the 6 test fish stations for the past 10 years. Station 4, which is on the east side of Cook Inlet, was the shallowest station, averaging 24.0 fathoms (144 feet) in depth. It should be noted, though, that changes in depth are a result of different stages of tide as well as minor differences in set location from day to day. Station 4 also had the clearest water, with a 1997–2006 secchi disk average depth of 8.1 m. In general, water clarity along the test fish transect decreases as you travel from east to west (secchi disk average depth decreases from 8.1 m at station 4 to 2.8 m at station 8) as a result of numerous glacial watersheds draining into the west side of Cook Inlet.

Since 2002, scale samples have been collected from all sockeye salmon that are measured to estimate mean length. The dominant age-class of sockeye salmon entering UCI at the test fish transect in 2006 was 1.3 (5-year olds), comprising 46% of the run (Table 8). This estimate compared favorably with age composition samples collected from districtwide drift gillnet harvests, which showed the 1.3 age-class comprised 48% of the harvest (Terri Tobias, Alaska Department of Fish and Game, Soldotna, personal communication). The scale samples from the OTF program were also collected with the intent of assessing whether or not Kenai River sockeye salmon, which are the dominant stock in Cook Inlet runs, might be identified using "size at age" criteria as they entered the district at the test fish transect. Statistical analyses will be conducted comparing the average size of each age-class of sockeye salmon collected at various escapement monitoring sites throughout UCI to the average size of the same age-classes collected at the 6 stations along the test fish transect. The results of this "mixture-model" analysis will be summarized in future test fish annual reports. In addition, beginning in 2005, sockeye salmon genetic samples were collected from the test fish harvest, with an objective to identify various UCI stocks using genetic markers (Habicht et al. 2007). Results of these analyses will also be provided in future test fish reports.

The UCI test fishery continues to provide fishery managers with very important data about the strength and timing of each year's sockeye salmon run. And, because commercial, sport, and personal use fishery management plans are intrinsically linked to the strength of the annual sockeye salmon run, the UCI test fishery is essentially relied upon to provide fishermen and fishery managers with an early indication of annual run strength and timing.

ACKNOWLEDGEMENTS

The authors would like to thank Roland Maw, captain of the *FV Americanus*, and the test fish crewmembers for conducting safe and efficient maritime activities.

In addition, we would like to thank Scott Pegau (Kachemak Bay National Estuarine Research Reserve) for his help in downloading data from CTD (Conductivity, Temperature, Depth profiler) casts.

REFERENCES CITED

Burgner, R. L. 1980. Some features of the ocean migrations and timing of Pacific salmon. Pages 153–163 [In]: Salmonid ecosystems of the north Pacific. W. J. McNeil and D. C. Himsworth, editors. Oregon State University Press, Corvallis, Oregon.

Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin International Pacific Salmon Fisheries Commission, No. 9, New Westminster, B.C.

Flynn, L., and R. Hilborn. 2004. Test fishery indices for sockeye salmon (*Oncorhynchus nerka*) as affected by age composition and environmental variables. Canadian Journal of Fisheries and Aquatic Sciences 61:80–92.

Habicht, C., W. D. Templin, L. W. Seeb, L. F. Fair, T. M. Willette, S. W. Raborn, and T. L. Lingnau. 2007. Postseason stock composition analysis of upper Cook Inlet sockeye salmon harvest, 2005–2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-07, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/fms07-07.pdf

Hilsinger, J. R. 1988. Run strength analysis of the 1987 sockeye salmon return to Upper Cook Inlet, Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A88-19, Anchorage.

Hilsinger, J. R., and D. Waltemyer. 1987. Run strength analysis of the 1986 sockeye salmon return to Upper Cook Inlet, Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Upper Cook Inlet Area Data Report 87-6, Soldotna.

Koo, T. S. Y. 1955. Biology of the red salmon, *Oncorhynchus nerka* (Walbaum), of Bristol Bay, Alaska as revealed by a study of their scales. Doctoral dissertation, University of Washington, Seattle.

Koo, T. S. Y. 1962. Age determination in salmon. Pages 37–48 [In]: Studies of Alaska red salmon, T. S. Y. Koo, editor. University of Washington Press, Seattle.

Mosher, K. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. United States Department of the Interior, Circular 317, Washington, D.C.

Mundy, P. R. 1979. A quantitative measure of migratory timing illustrated by application to the management of commercial salmon fisheries. Doctoral dissertation, University of Washington, Seattle, Washington.

Mundy, P. R., K. K. English, W. J. Gazey, and K. E. Tarbox. 1993. Evaluation of the harvest management strategies applied to sockeye salmon populations of Upper Cook Inlet, Alaska, using run reconstruction analysis. [In]: G. Kruse, D. M. Eggers, R. J. Marasco, C. Pautzke, and T. J. Quinn II, editors. Proceedings of the international symposium on management strategies for exploited fish populations. Alaska Sea Grant College Program, University of Alaska, Fairbanks.

Pearcy, W. G. 1992. Ocean ecology of North Pacific salmonids. Washington Sea Grant Program. University of Washington Press, Seattle, WA.

Shields, P. 2000. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 2000. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A00-30, Anchorage.

Shields, P. 2001. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A01-14, Anchorage.

Shields, P. 2003. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A03-01, Anchorage.

Shields, P. 2006. Upper Cook Inlet commercial fisheries annual management report, 2005. Alaska Department of Fish and Game, Fishery Management Report No. 06-42, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr06-42.pdf

Shields, P. 2007. Upper Cook Inlet commercial fisheries annual management report, 2006. Alaska Department of Fish and Game, Fishery Management Report No. 07-36, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr07-36.pdf

Shields, P., and M. Willette. 2004. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A04-15, Anchorage.

Shields, P., and M. Willette. 2005. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-64, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-64.pdf

Tarbox, K. E. 1990. An estimate of the migratory timing of sockeye salmon into Upper Cook, Alaska, in 1989 using a test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A90-4, Anchorage.

Tarbox, K. E. 1991. An estimate of the migratory timing of sockeye salmon into Upper Cook, Alaska, in 1990 using a test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A91-6, Anchorage.

Tarbox, K. E. 1994. An estimate of the migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1993. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A94-13, Anchorage.

Tarbox, K. E. 1995. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A95-15, Anchorage.

Tarbox, K. E. 1996. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1995. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A96-07, Anchorage.

Tarbox, K. E. 1997. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1996. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A97-01, Anchorage.

Tarbox, K. E. 1998a. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1997. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A98-22, Anchorage.

Tarbox, K. E. 1998b. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1998. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A98-30, Anchorage.

Tarbox, K. E. 1999. An estimate of migratory timing and abundance of sockeye salmon into Upper Cook Inlet, Alaska, in 1999. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 2A99-13, Anchorage.

Tarbox, K. E., and B. King. 1992. An estimate of the migratory timing of sockeye salmon into Upper Cook Inlet, Alaska, in 1991 using a test fishery. Division of Commercial Fisheries, Regional Information Report 2A92-07, Anchorage.

Tarbox, K. E., and D. Waltemyer. 1989. An estimate of the 1988 total sockeye salmon return to Upper Cook Inlet, Alaska using a test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A89-4, Anchorage.

Tobias, T. M., D. L. Waltemyer, and K. E. Tarbox. 1994. Scale aging manual for Upper Cook Inlet sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A94-36, Anchorage.

REFERENCES CITED (Continued)

Tobias, T. M., and M. Willette. 2003. An estimate of total return of sockeye salmon to Upper Cook Inlet, Alaska, 1976–2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A03-11, Anchorage.

Waltemyer, D. L. 1983a. Migratory timing and abundance estimation of the 1982 sockeye salmon return to Upper Cook Inlet based on a test fishing program. Alaska Department of Fish and Game, Division of Commercial Fisheries, Upper Cook Inlet Data Report 83-1, Soldotna.

Waltemyer, D. L. 1983b. Describing the migrations of salmon and estimating abundance of sockeye salmon returning in 1983 to Upper Cook Inlet based on a test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Upper Cook Inlet Data Report 84-1, Soldotna.

Waltemyer, D. L. 1986a. Use of a test fishery to describe and estimate the sockeye salmon total return to Upper Cook Inlet in 1984. Alaska Department of Fish and Game, Division of Commercial Fisheries, Upper Cook Inlet Data Report 86-1, Soldotna.

Waltemyer, D. L. 1986b. Run strength analysis of the 1985 sockeye salmon return to Upper Cook Inlet, Alaska based on a test fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Upper Cook Inlet Data Report 86-5, Soldotna.

TABLES AND FIGURES

Table 1.–Summary of sockeye salmon fishing effort, daily and cumulative catch, and daily and cumulative catch per unit of effort (CPUE), Upper Cook Inlet offshore test fish project, 2006.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE		Mean Length (mm)
			Daily	Cum	Daily	Cum	
7/1	6	226.5	13	13	10	10	521
7/2	6	221.0	15	28	12	22	535
7/3	6	230.5	51	79	37	58	547
7/4	6	231.0	33	112	25	84	572
7/5	6	224.0	29	141	23	106	554
7/6	6	223.0	42	183	31	138	559
7/7	6	239.0	60	243	43	181	542
7/8	6	229.0	74	317	52	233	548
7/9	6	225.5	41	358	31	264	554
7/10	6	218.6	16	374	13	277	530
7/11	6	235.5	53	427	38	315	549
7/12	6	241.0	50	477	36	351	538
7/13	6	229.0	45	522	35	386	538
7/14	4[a]	254.8	79	601	48	434	551
7/15	2[a]	247.5	63	664	44	478	552
7/16	6	230.0	33	697	23	501	557
7/17	6	252.0	139	836	92	593	548
7/18	6	235.0	58	894	43	636	553
7/19	6	262.0	77	971	48	684	550
7/20	0[a]	0	79	1,050	50	735	551
7/21	6	260.0	80	1,130	52	787	552
7/22	6	249.0	74	1,204	45	832	553
7/23	4[a]	225.5	146	1,350	72	904	565
7/24	4[a]	187.5	148	1,498	77	981	555
7/25	6	256.5	131	1,629	84	1,064	563
7/26	6	212.5	3	1,632	2	1,067	588
7/27	6	250.0	124	1,756	80	1,147	551
7/28	5[a]	213.5	80	1,836	49	1,195	553
7/29	0[a]	0	128	1,964	71	1,266	
7/30	0[a]	0	128	2,092	71	1,338	
7/31	6	239.0	28	2,120	20	1,357	546
8/1	6	303.5	278	2,398	150	1,507	565

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Table 2.–Estimated sockeye salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	4	0	5	3	1	0	13
7/2	0	0	5	1	8	1	15
7/3	16	30	2	2	1	0	51
7/4	4	14	5	6	2	2	33
7/5	13	10	4	2	0	0	29
7/6	18	18	4	0	0	2	42
7/7	0	14	18	20	7	1	60
7/8	58	9	3	3	0	1	74
7/9	2	6	3	23	6	1	41
7/10	3	9	1	2	1	0	16
7/11	0	0	34	10	6	3	53
7/12	20	0	15	9	4	2	50
7/13	0	26	10	4	0	5	45
7/14[a]	5	5	21	39	6	3	79
7/15[a]	10	5	22	20	3	3	63
7/16	2	7	24	0	0	0	33
7/17	16	27	14	9	67	6	139
7/18	5	18	15	13	6	1	58
7/19	2	46	4	22	2	1	77
7/20[a]	3	30	14	23	7	2	79
7/21	4	14	23	24	12	3	80
7/22	3	1	58	4	6	2	74
7/23[a]	0	4	24	110	7	1	146
7/24[a]	2	1	27	110	7	1	148
7/25	0	18	15	80	16	2	131
7/26	0	3	0	0	0	0	3
7/27	0	3	58	20	40	3	124
7/28[a]	1	11	12	11	43	2	80
7/29[a]	4	13	34	31	44	2	128
7/30[a]	4	13	34	31	44	2	128
7/31	1	0	12	5	8	2	28
8/1	10	28	77	78	82	3	278
Total	210	383	597	715	436	57	2,398
Percent	8.8%	16.0%	24.9%	29.8%	18.2%	2.4%	100%

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Table 3.–Estimated sockeye salmon catch per unit of effort (CPUE) by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	3	0	4	2	1	0	10
7/2	0	0	4	1	6	1	12
7/3	13	20	1	2	1	0	37
7/4	3	11	4	5	2	2	25
7/5	10	8	3	2	0	0	23
7/6	13	13	3	0	0	2	31
7/7	0	10	14	13	5	1	43
7/8	39	7	2	2	0	1	52
7/9	2	5	2	16	5	1	31
7/10	3	7	1	2	1	0	13
7/11	0	0	24	7	5	2	38
7/12	15	0	10	7	3	2	36
7/13	0	21	7	3	0	4	35
7/14[a]	4	4	14	20	4	3	48
7/15[a]	7	4	14	14	2	3	44
7/16	2	5	16	0	0	0	23
7/17	11	21	11	7	38	5	92
7/18	4	14	11	9	4	1	43
7/19	2	28	3	14	1	1	48
7/20[a]	2	19	8	14	5	2	50
7/21	3	10	14	14	9	2	52
7/22	2	1	33	3	5	2	45
7/23[a]	0	3	14	49	6	1	72
7/24[a]	2	1	18	50	6	1	77
7/25	0	14	11	46	12	1	84
7/26	0	2	0	0	0	0	2
7/27	0	3	36	14	25	3	80
7/28[a]	1	7	8	8	24	2	49
7/29[a]	3	9	19	17	22	2	71
7/30[a]	3	9	19	17	22	2	71
7/31	1	0	8	3	6	2	20
8/1	7	19	40	40	42	2	150
Total	152	273	374	399	262	47	1,506
Percent	10.1%	18.1%	24.8%	26.5%	17.4%	3.1%	100%

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Table 4.–Total run estimates for sockeye salmon to Upper Cook Inlet, Alaska, made during the 2006 season.

Based on data through 7/24/2006	
Escapement	664,413
Cumulative Catch (Commercial, Sport, & Personal Use)	1,339,500
Residual in District	300,000
Total Run Through 7/24/2006 =	2,303,913
2006 Cumulative Offshore Test Fish CPUE through 7/24/2005 =	972
Passage Rate (Total Run/Cumulative CPUE) based on 7/21/2005 harvest =	2,370

Run Estimates Based on Model Results (Fit of Current Year to Past Years)

	Mean Sum	Estimated Total CPUE				Estimated
Year	of Squares	Current	Previous Day	Difference	Timing	Total Run
1994	0.000389	1,518	1,513	5	Late 4 days	3,597,186
1991	0.000554	1,200	1,195	6	Late 2 days	2,844,764
2004	0.000559	1,221	1,217	4	Late 2 days	2,895,108
2005	0.000611	1,622	1,613	9	Late 6 days	3,844,833
1987	0.000612	1,390	1,394	-4	Late 2 days	3,294,453
1983	0.000768	1,084	1,069	15	On Time	2,569,219
1995	0.000841	1,042	1,027	14	On Time	2,468,766
1997	0.001037	1,259	1,244	15	Late 1 day	2,984,539
1998	0.001055	1,241	1,225	16	Late 3 days	2,941,566
2003	0.001352	992	974	18	Early 2 days	2,352,385
1999	0.001354	1,256	1,260	-4	Late 3 days	2,977,144
1986	0.001508	1,080	1,062	19	Late 1 day	2,560,662
1982	0.001749	1,104	1,085	19	Late 2 days	2,617,406
1992	0.001861	1,215	1,218	-4	Late 2 days	2,879,583
1993	0.001989	1,026	1,006	20	Early 1 day	2,432,311
1996	0.002030	949	929	20	Early 2 days	2,249,634
1990	0.002830	1,384	1,404	-20	Late 3 days	3,279,639
1985	0.002935	1,051	1,029	22	On Time	2,492,113
1988	0.003410	1,022	999	23	Early 2 days	2,421,479
2000	0.003573	879	856	23	Early 2 days	2,083,145
2002	0.004778	897	872	25	Early 1 days	2,126,592
2001	0.005345	893	868	25	Early 2 days	2,116,329
1989	0.009000	1,081	1,051	30	On Time	2,561,349
1984	0.010708	870	842	28	Early 4 days	2,062,524
1979	0.020757	794	763	31	Early 5 days	1,881,458
1981	0.048846	742	708	34	Early 9 days	1,759,483
1980	0.049046	761	726	35	Early 9 days	1,803,642

Table 4.–Page 2 of 2.

Based on data through 7/31/2006	
Escapement	1,388,298
Cumulative Catch (Commercial, Sport, & Personal Use)	1,885,803
Residual in District	174,224
TOTAL RUN THROUGH 7/31/2006 =	3,448,325
2006 Cumulative Offshore Test Fish CPUE through 7/31/2006 =	1,286
Passage Rate (Total Run/Cumulative CPUE) through 7/31/2006 =	2,681

Run Estimates Based on Model Results (Fit of Current Year to Past Years)

	Mean Sum	Estimated Total CPUE				Estimated
Year	of Squares	Current	Previous Day	Difference	Timing	Total Run
1994	0.000368	1,547	1,545	2	Late 4 days	4,147,080
1987	0.000543	1,406	1,403	3	Late 2 days	3,770,794
2005	0.000550	1,658	1,658	0	Late 6 days	4,446,489
2004	0.001199	1,290	1,280	10	Late 2 days	3,458,300
1991	0.001389	1,275	1,264	11	Late 2 days	3,419,580
1999	0.001400	1,296	1,288	8	Late 3 days	3,474,040
1992	0.001980	1,262	1,253	9	Late 2 days	3,384,909
1997	0.002004	1,360	1,349	11	Late 1 day	3,645,839
1998	0.002157	1,344	1,333	12	Late 3 days	3,604,947
1990	0.002358	1,356	1,354	2	Late 3 days	3,635,704
1983	0.003671	1,205	1,189	16	On Time	3,229,815
1995	0.004534	1,167	1,150	17	On Time	3,129,288
1982	0.004639	1,237	1,221	16	Late 2 days	3,316,425
1986	0.004793	1,214	1,197	16	Late 1 day	3,254,001
1993	0.006674	1,172	1,154	18	Early 1 day	3,142,051
2003	0.006847	1,136	1,118	19	Early 2 days	3,047,290
1985	0.007102	1,201	1,183	18	On Time	3,219,250
1988	0.008418	1,177	1,158	19	Early 2 days	3,156,370
1996	0.009442	1,106	1,086	20	Early 2 days	2,965,640
1989	0.012792	1,260	1,240	20	On Time	3,377,723
2000	0.015204	1,054	1,031	23	Early 2 days	2,825,267
2002	0.015364	1,074	1,052	22	Early 1 days	2,880,451
2001	0.016230	1,072	1,049	23	Early 2 days	2,874,632
1984	0.023044	1,062	1,039	24	Early 4 days	2,848,863
1979	0.039644	1,004	978	26	Early 5 days	2,692,402
1980	0.068319	987	959	28	Early 9 days	2,645,986
1981	0.071128	969	941	28	Early 9 days	2,598,042

Table 5.–Estimated total Kenai River sockeye salmon run (millions) in 2006 estimated from total offshore test fish catch per unit of effort (CPUE) and age composition stock allocation estimates through July 24 and July 31, 2006.

Data through 24 July

Year	MSS	Est. Total Offshore Test Fish CPUE: Current	Est. Total Offshore Test Fish CPUE: Prev. Day	Est. Total Offshore Test Fish CPUE: Timing	Passage Rate	Estimated UCI Total run	Estimated UCI Run to Date[a]	Estimated UCI Run Remaining	Estimated Kenai Run to Date	Prop. Kenai	Estimated Kenai Run Remaining	Estimated Total Kenai Return
1994	0.00039	1,518	1,513	Late 4 days	2,370	3.60	2.00	1.59	0.53	52%	0.830	1.360
1991	0.00055	1,200	1,195	Late 2 days	2,370	2.84	2.00	0.84	0.53	52%	0.438	0.968
2004	0.00056	1,221	1,217	Late 2 days	2,370	2.89	2.00	0.89	0.53	52%	0.464	0.994
2005	0.00061	1,622	1,613	Late 7 days	2,370	3.84	2.00	1.84	0.53	52%	0.959	1.489
1987	0.00061	1,390	1,394	Late 2 days	2,370	3.29	2.00	1.29	0.53	52%	0.672	1.202

Data through 31 July

Year	MSS	Est. Total Offshore Test Fish CPUE: Current	Est. Total Offshore Test Fish CPUE: Prev. Day	Est. Total Offshore Test Fish CPUE: Timing	Passage Rate	Estimated UCI Total run	Estimated UCI Run to Date[a]	Estimated UCI Run Remaining	Estimated Kenai Run to Date	Prop. Kenai	Estimated Kenai Run Remaining	Estimated Total Kenai Return
1994	0.00037	1,547	1,545	Late 4 days	2,681	4.15	3.27	0.87	1.42	66%	0.573	1.993
1987	0.00054	1,406	1,403	Late 2 days	2,681	3.77	3.27	0.50	1.42	66%	0.326	1.746
2005	0.00055	1,658	1,658	Late 7 days	2,681	4.45	3.27	1.17	1.42	66%	0.769	2.189
2004	0.00120	1,290	1,280	Late 2 days	2,681	3.46	3.27	0.18	1.42	66%	0.121	1.541
1991	0.00139	1,275	1,264	Late 2 days	2,681	3.42	3.27	0.15	1.42	66%	0.095	1.515

Note: MSS is the mean sum of squares.
[a] Does not include residual fish still resident in the Central District.

Table 6.–A comparison of methods used to make postseason adjustments to the offshore test fish final catch per unit of effort (CPUE).

Year	Final OTF CPUE	Postseason Offshore Test Fish CPUE Adjustment		Harvest Adjusted		Total Run Adjusted	
		Harvest-adjusted	Total Run-adjusted	*a*	*b*	*a*	*b*
1979	602	651	664	-3.2451	0.1876	-3.3380	0.2004
1980	740	770	777	-2.2537	0.1640	-2.2403	0.1612
1981	364	383	387	-2.5459	0.1856	-2.5243	0.1819
1982	651	775	786	-3.6839	0.1522	-3.7156	0.1633
1983	2,464	2,472	2,474	-4.2719	0.1883	-4.2732	0.1884
1984	1,331	1,334	1,341	-3.4257	0.1855	-3.4018	0.1834
1985	1,422	1,575	1,563	-3.4581	0.1523	-3.5633	0.1626
1986	1,653	1,731	1,714	-3.7671	0.1633	-3.8642	0.1719
1987	1,404	1,422	1,428	-4.3442	0.1689	-4.6385	0.1785
1988	1,131	1,145	1,169	-3.3682	0.1639	-3.5655	0.1662
1989	619	682	692	-2.7114	0.1258	-2.7031	0.1238
1990	1,358	1,404	1,426	-5.7913	0.2259	-5.7085	0.2211
1991	1,574	1,759	1,740	-4.5806	0.1885	-4.6331	0.1919
1992	2,021	2,186	2,195	-5.4366	0.2235	-5.4043	0.2217
1993	1,815	1,882	1,913	-4.0776	0.1906	-3.9018	0.1797
1994	1,012	1,145	1,199	-4.0770	0.1553	-3.9757	0.1453
1995	1,712	1,828	1,850	-4.7036	0.2131	-4.6219	0.2078
1996	1,723	1,765	1,796	-4.6328	0.2266	-4.4605	0.2144
1997	1,656	1,705	1,826	-3.8265	0.1621	-3.7000	0.1496
1998	1,158	1,355	1,313	-3.6700	0.1473	-3.7142	0.1515
1999	2,226	2,475	2,419	-5.3100	0.2175	-5.1500	0.2081
2000	1,520	1,532	1,565	-5.1094	0.2614	-4.9141	0.2480
2001	1,586	1,594	1,630	-3.9323	0.2002	-3.9823	0.2041
2002	1,736	1,749	1,825	-4.3694	0.2292	-4.0642	0.2068
2003	1,787	1,824	1,848	-4.5091	0.2117	-4.4402	0.2068
2004	2,028	2,220	2,345	-4.6374	0.1903	-4.6374	0.1903
2005	2,643	3,015	3,180	-3.7499	0.1360	-3.7170	0.1305
2006	1,507	1,756	1,969	-4.2031	0.1438	-4.0762	0.1308

Table 7.–Mean date of the sockeye salmon run across the Anchor Point transect, Upper Cook Inlet offshore test fish project, 1979-2006.

	Mean Date[a]	
Year	Coded	Calendar
1979	16.7	10-Jul
1980	13.9	7-Jul
1981	13.9	7-Jul
1982	22.8	16-Jul
1983	22.7	16-Jul
1984	18.5	12-Jul
1985	21.9	15-Jul
1986	22.5	16-Jul
1987	26.0	19-Jul
1988	21.4	14-Jul
1989	21.8	15-Jul
1990	25.8	19-Jul
1991	24.1	17-Jul
1992	24.4	17-Jul
1993	21.7	15-Jul
1994	27.4	20-Jul
1995	22.2	15-Jul
1996	20.8	14-Jul
1997	24.7	18-Jul
1998	24.5	18-Jul
1999	24.7	18-Jul
2000	19.8	13-Jul
2001	19.5	13-Jul
2002	19.7	13-Jul
2003	21.5	14-Jul
2004	24.4	17-Jul
2005	28.5	21-Jul
1979-2004 Average	22.1	15-Jul
2006	31.2	24-Jul

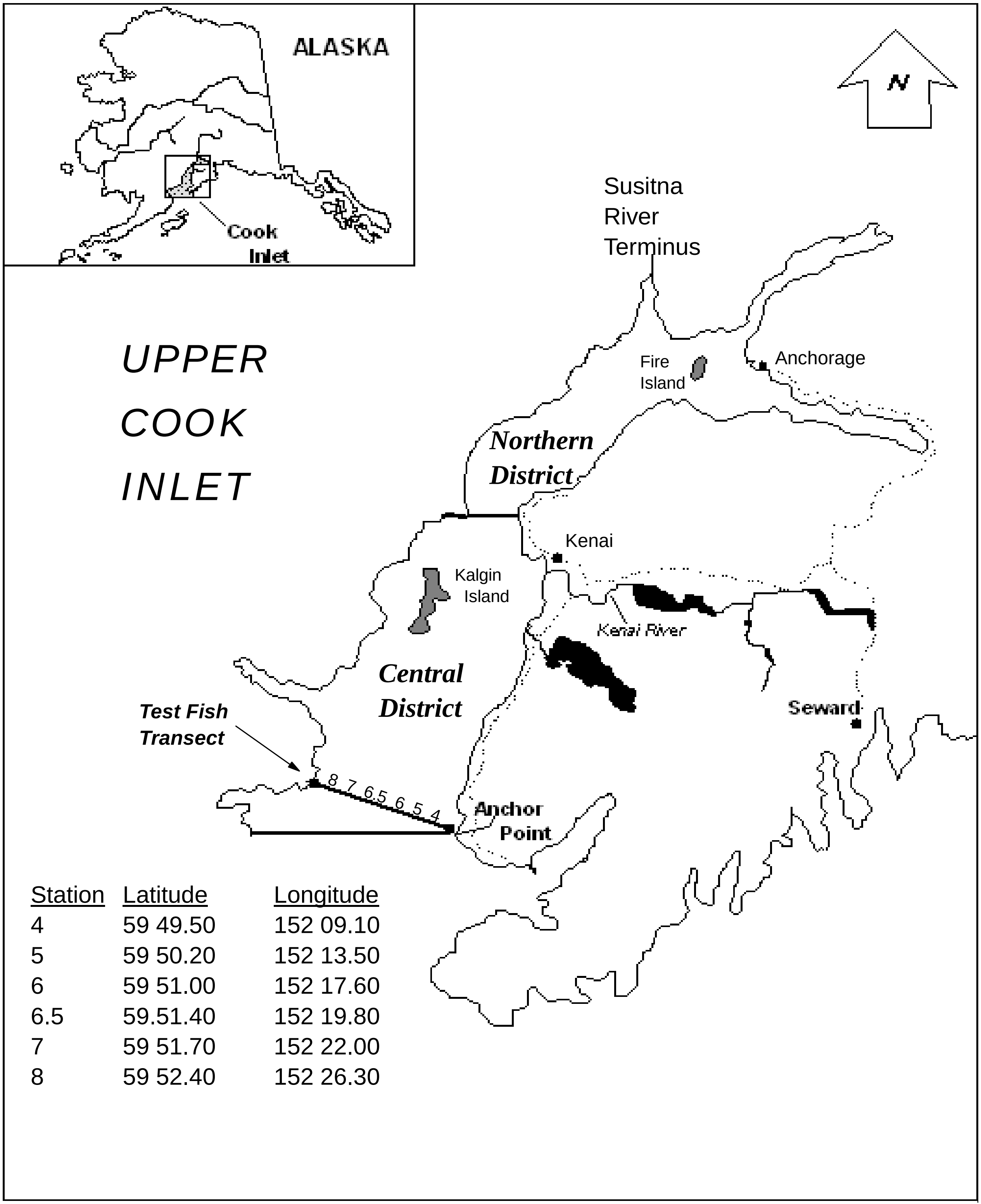
[a] Day (1) = June 24.

Table 8.–Sockeye salmon age-composition, mean length (mm), and number of samples by station, Upper Cook Inlet offshore test fish project, 2006.

Station No.	Sample Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	140	0.5	25.5	41.2	6.4	0.5	26.0			
5	249		14.7	51.8	5.2	1.6	26.4	0.3		
6	318	0.3	11.7	48.2	4.8	2.2	32.8			
6.5	257	1.9	16.0	40.6	3.3	2.4	35.9			
7	130	0.8	17.0	41.3	5.5	1.6	33.9			
8	32		7.0	45.6	7.0		40.4			
Weighted Avg =		1.4	16.8	46.0	5.1	2.0	32.1	0.3		

Station No.	Sample Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	140	540	504	553	515	585	565			
5	249		493	552	502	607	570	626		
6	318	560	497	557	516	596	571			
6.5	257	576	508	559	492	607	571			
7	130	570	488	553	514	595	563			
8	32		525	566	545		566			
Weighted Avg =		569	499	556	510	601	569	626		

Station No.	Sample Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	140	1	36	57	9	1	36			
5	249		37	128	13	4	66	1		
6	318	1	37	154	15	7	104			
6.5	257	5	41	105	8	6	92			
7	130	1	22	54	7	2	44			
8	32		2	15	2		13			
Station Total =		8	175	513	54	20	355	1	0	0



Station	Latitude	Longitude
4	59 49.50	152 09.10
5	59 50.20	152 13.50
6	59 51.00	152 17.60
6.5	59.51.40	152 19.80
7	59 51.70	152 22.00
8	59 52.40	152 26.30

Figure 1.–Location of fishing districts and offshore test fish transect in Cook Inlet, Alaska 2006.

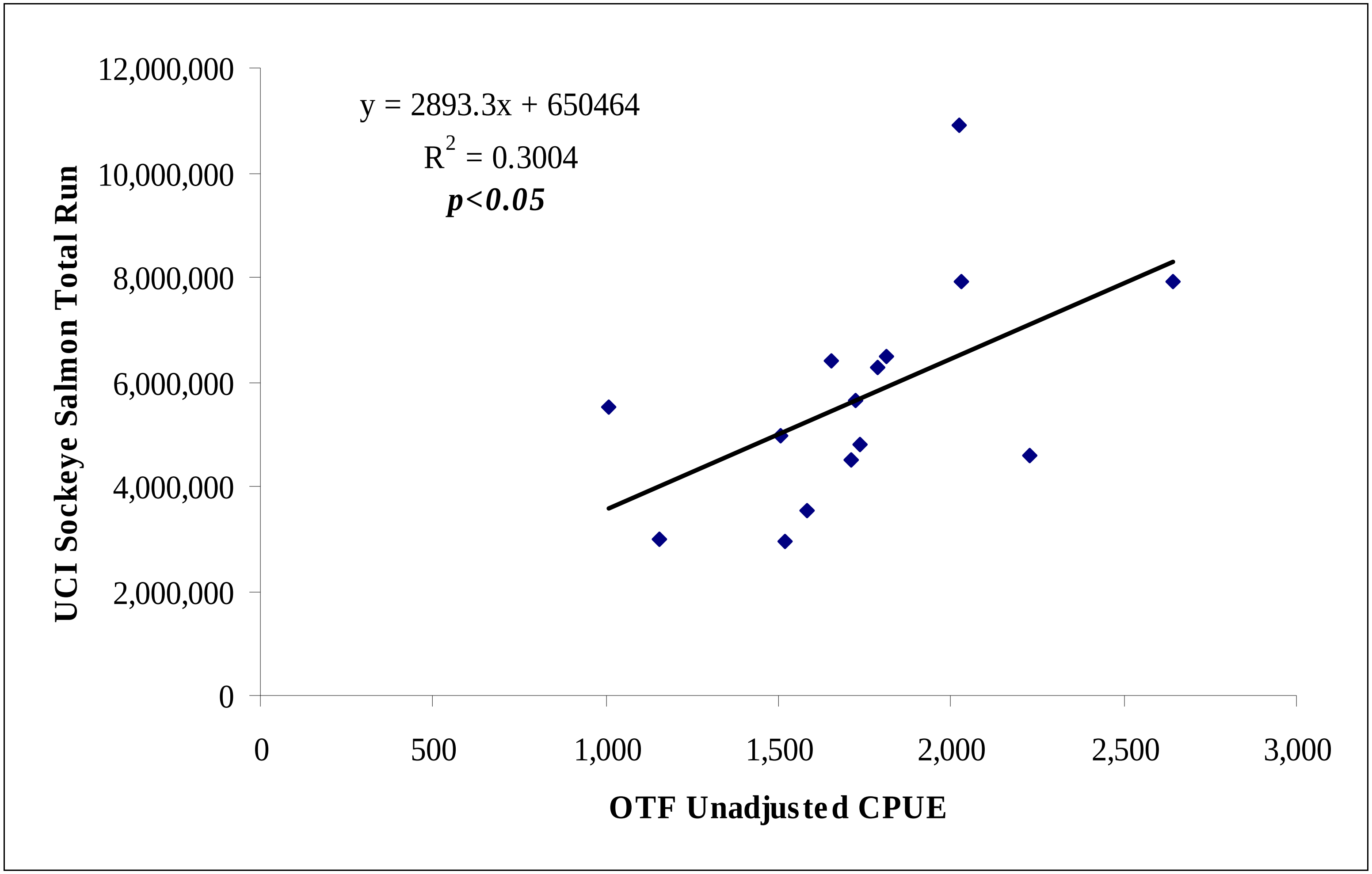


Figure 2.–Linear regression of the relationship between offshore test fish unadjusted cumulative catch per unit of effort (CPUE) and Upper Cook Inlet sockeye salmon total annual run.

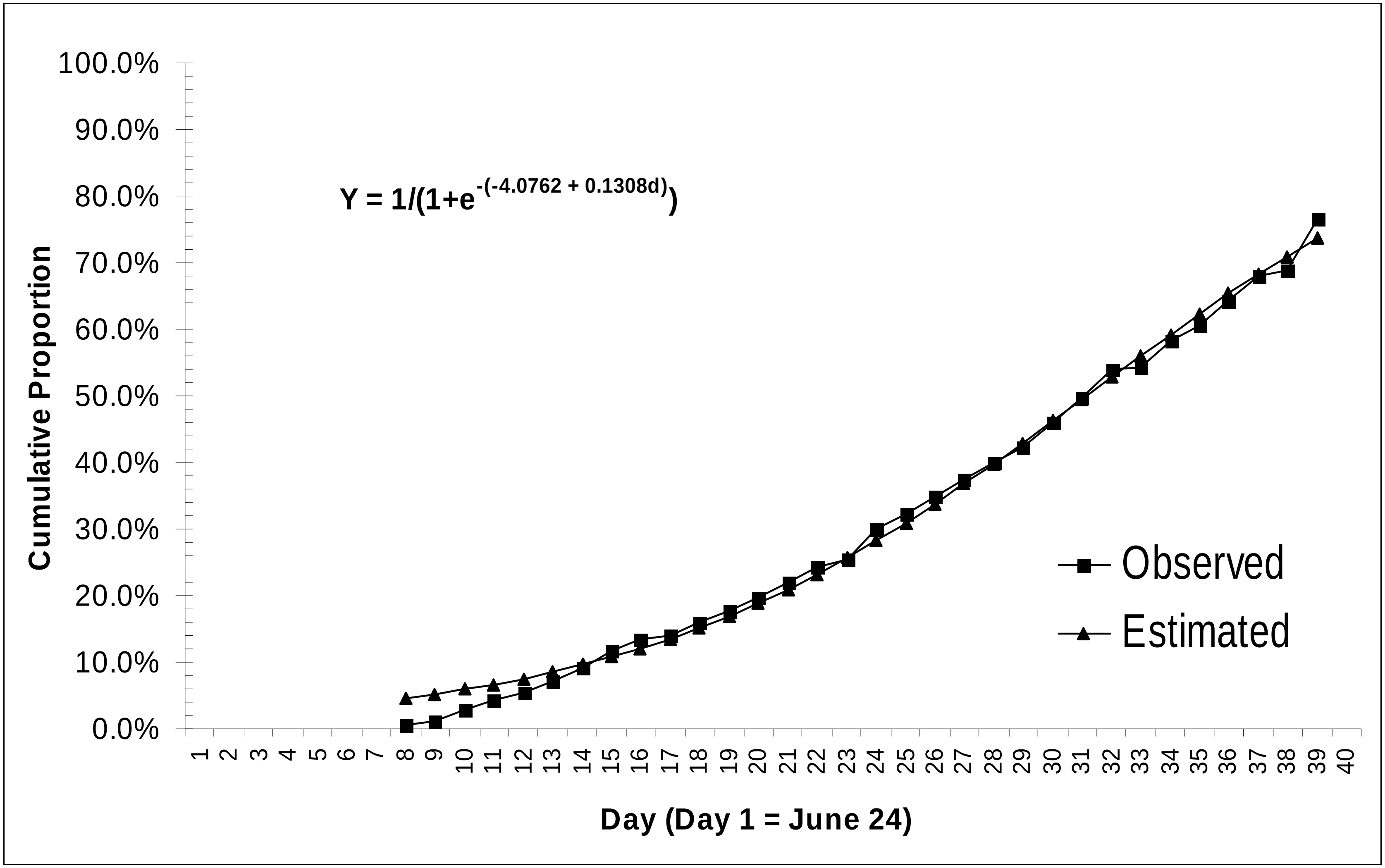


Figure 3.–Cumulative proportions estimated for the sockeye salmon run to Upper Cook Inlet, Alaska, 2006.

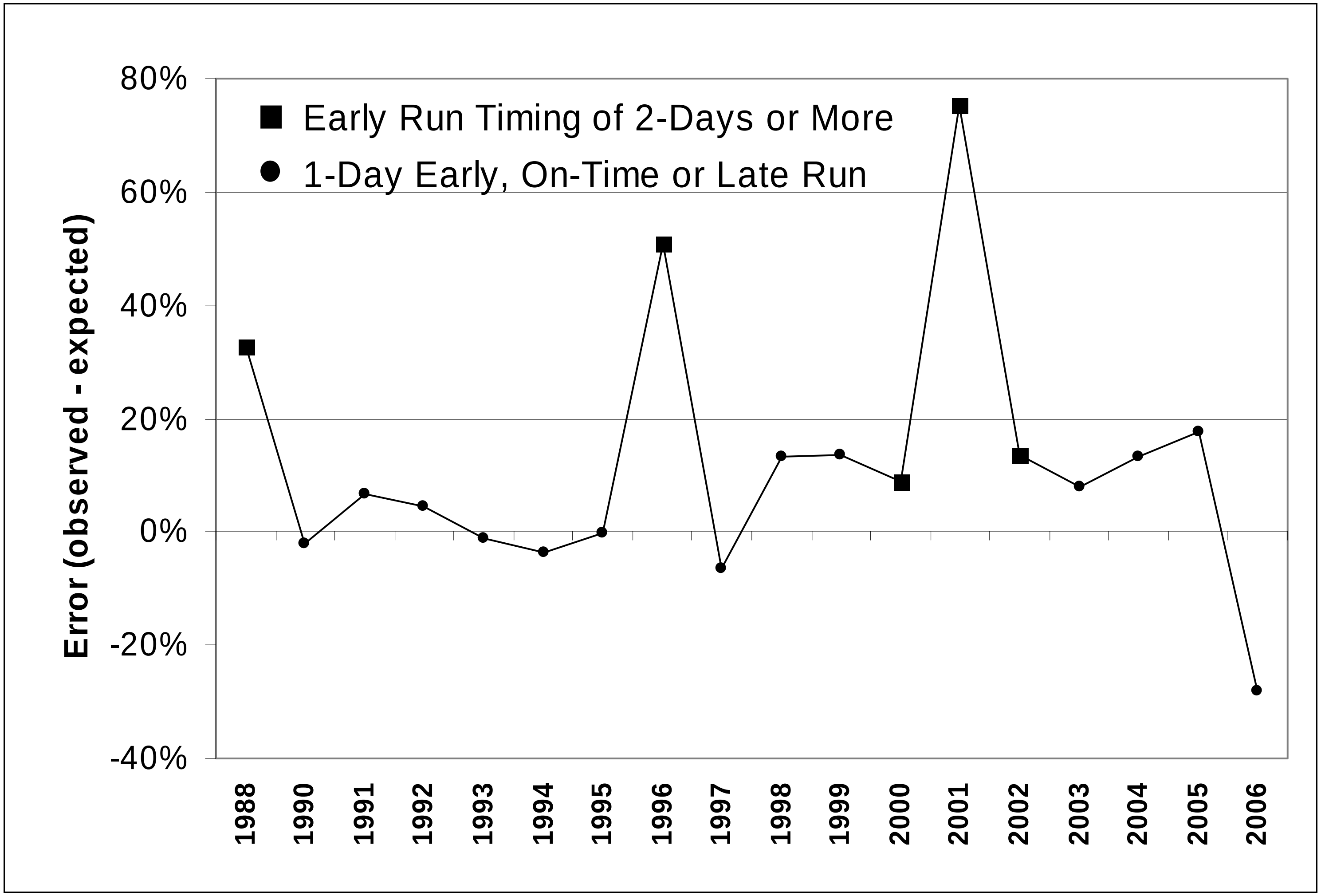


Figure 4.–Offshore Test Fish (OTF) error in forecasting the total run of sockeye salmon to Upper Cook Inlet using the 20 July best-fit estimate.

APPENDIX A

Appendix A1.–Summary of pink salmon fishing effort, daily and cumulative catch, and daily and cumulative catch per unit of effort (CPUE), Upper Cook Inlet offshore test fish project, 2006.

Date	Number of Stations	Mean Fishing Time (min)	CATCH Daily	CATCH Cum	CPUE Daily	CPUE Cum
7/1	6	226.5	0	0	0	0
7/2	6	221.0	0	0	0	0
7/3	6	230.5	2	2	2	2
7/4	6	231.0	1	3	1	2
7/5	6	224.0	0	3	0	2
7/6	6	223.0	0	3	0	2
7/7	6	239.0	4	7	3	5
7/8	6	229.0	9	16	6	11
7/9	6	225.5	6	22	5	16
7/10	6	218.6	3	25	2	18
7/11	6	235.5	6	31	5	23
7/12	6	241.0	15	46	10	33
7/13	6	229.0	12	58	9	43
7/14	4[a]	254.8	32	90	21	64
7/15	2[a]	247.5	28	118	20	83
7/16	6	230.0	10	128	8	91
7/17	6	252.0	62	190	38	128
7/18	6	235.0	28	218	20	149
7/19	6	262.0	114	332	72	221
7/20	0[a]	0.0	99	431	64	285
7/21	6	260.0	83	514	55	339
7/22	6	249.0	72	586	47	386
7/23	4[a]	225.5	47	633	27	412
7/24	4[a]	187.5	56	689	30	443
7/25	6	256.5	33	722	22	465
7/26	6	212.5	5	727	4	469
7/27	6	250.0	29	756	19	488
7/28	5[a]	213.5	55	811	36	524
7/29	0[a]	0.0	53	864	33	557
7/30	0[a]	0.0	53	917	33	590
7/31	6	239.0	18	935	13	603
8/1	6	303.5	88	1,023	52	655

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A2.–Estimated pink salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	0	0	0	0	0
7/2	0	0	0	0	0	0	0
7/3	0	1	0	1	0	0	2
7/4	0	1	0	0	0	0	1
7/5	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0
7/7	0	0	0	3	1	0	4
7/8	7	2	0	0	0	0	9
7/9	0	3	1	2	0	0	6
7/10	1	2	0	0	0	0	3
7/11	0	0	0	1	4	1	6
7/12	2	0	8	5	0	0	15
7/13	0	8	3	1	0	0	12
7/14[a]	3	3	9	8	8	1	32
7/15[a]	6	5	6	5	5	1	28
7/16	0	4	3	2	1	0	10
7/17	1	2	3	1	51	4	62
7/18	1	4	7	7	9	0	28
7/19	9	72	14	8	11	0	114
7/20[a]	6	41	17	16	17	2	99
7/21	3	10	20	23	23	4	83
7/22	6	5	42	15	3	1	72
7/23[a]	4	5	16	19	2	1	47
7/24[a]	4	3	8	38	2	1	56
7/25	7	7	7	9	2	1	33
7/26	0	2	2	0	0	1	5
7/27	1	3	17	2	5	1	29
7/28[a]	3	25	5	13	7	2	55
7/29[a]	6	13	11	8	11	4	53
7/30[a]	6	13	11	8	11	4	53
7/31	3	0	8	3	4	0	18
8/1	13	13	20	8	23	11	88
Total	92	247	238	206	200	40	1,023
Percent	9	24	23	20	20	4	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A3.–Estimated pink salmon catch per unit of effort (CPUE) by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/3	0.0	0.7	0.0	0.8	0.0	0.0	1.5
7/4	0.0	0.7	0.0	0.0	0.0	0.0	0.7
7/5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/7	0.0	0.0	0.0	2.0	0.7	0.0	2.7
7/8	4.7	1.6	0.0	0.0	0.0	0.0	6.3
7/9	0.0	2.4	0.8	1.4	0.0	0.0	4.7
7/10	0.8	1.6	0.0	0.0	0.0	0.0	2.4
7/11	0.0	0.0	0.0	0.7	3.0	0.8	4.6
7/12	1.5	0.0	5.2	3.6	0.0	0.0	10.3
7/13	0.0	6.3	2.2	0.7	0.0	0.0	9.3
7/14[a]	2.2	2.4	5.9	4.0	5.7	1.0	21.2
7/15[a]	4.4	3.8	3.9	3.1	3.2	1.0	19.5
7/16	0.0	3.1	1.9	1.7	0.8	0.0	7.5
7/17	0.7	1.5	2.3	0.8	29.1	3.2	37.6
7/18	0.8	3.1	5.0	5.1	6.5	0.0	20.4
7/19	6.6	43.2	9.7	5.2	7.6	0.0	72.2
7/20[a]	4.4	25.3	10.8	9.4	11.9	1.6	63.5
7/21	2.3	7.3	12.0	13.7	16.2	3.2	54.7
7/22	4.5	3.9	24.0	11.0	2.3	0.8	46.5
7/23[a]	3.2	4.0	9.0	8.4	1.3	0.8	26.6
7/24[a]	3.2	2.4	5.4	17.1	1.3	0.8	30.2
7/25	4.3	5.2	5.2	5.1	1.5	0.6	22.0
7/26	0.0	1.6	1.7	0.0	0.0	0.8	4.1
7/27	0.9	2.5	10.4	1.3	3.2	0.8	19.1
7/28[a]	2.4	15.5	3.3	9.0	4.1	1.5	35.8
7/29[a]	4.6	8.0	6.3	4.9	6.3	3.2	33.4
7/30[a]	4.6	8.0	6.3	4.9	6.3	3.2	33.4
7/31	2.5	0	5.4	1.9	3.0	0	12.8
8/1	8.9	8.9	10.3	4.1	11.9	8.1	52.1
Total	68	163	147	120	126	31	655
Percent	10	25	22	18	19	5	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A4.–Summary of chum salmon fishing effort, daily and cumulative catch, and daily and cumulative catch per unit of effort (CPUE), Upper Cook Inlet offshore test fish project, 2006.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	226.5	10	10	8	8
7/2	6	221.0	27	37	21	29
7/3	6	230.5	13	50	9	38
7/4	6	231.0	14	64	11	49
7/5	6	224.0	21	85	16	65
7/6	6	223.0	12	97	9	74
7/7	6	239.0	69	166	49	123
7/8	6	229.0	7	173	5	128
7/9	6	225.5	23	196	18	146
7/10	6	218.6	1	197	1	147
7/11	6	235.5	9	206	7	153
7/12	6	241.0	36	242	24	177
7/13	6	229.0	10	252	8	185
7/14	4[a]	254.8	45	297	27	212
7/15	2[a]	247.5	48	345	30	241
7/16	6	230.0	53	398	35	277
7/17	6	252.0	35	433	25	302
7/18	6	235.0	25	458	18	320
7/19	6	262.0	24	482	16	336
7/20	0[a]	0.0	30	512	19	354
7/21	6	260.0	32	544	21	375
7/22	6	249.0	12	556	7	382
7/23	4[a]	225.5	56	612	28	410
7/24	4[a]	187.5	32	644	17	427
7/25	6	256.5	36	680	22	449
7/26	6	212.5	2	682	2	451
7/27	6	250.0	21	703	13	464
7/28	5[a]	213.5	49	752	32	496
7/29	0[a]	0.0	57	809	34	530
7/30	0[a]	0.0	57	866	34	564
7/31	6	239.0	37	903	25	589
8/1	6	303.5	85	988	45	635

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A5.–Estimated chum salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	3	6	1	0	10
7/2	0	0	4	7	16	0	27
7/3	0	12	0	0	1	0	13
7/4	4	3	5	1	1	0	14
7/5	9	8	1	2	0	1	21
7/6	8	3	1	0	0	0	12
7/7	1	7	0	27	19	15	69
7/8	3	3	1	0	0	0	7
7/9	2	2	2	13	4	0	23
7/10	0	1	0	0	0	0	1
7/11	0	1	4	3	1	0	9
7/12	0	0	28	8	0	0	36
7/13	0	1	7	2	0	0	10
7/14[a]	0	0	13	25	6	1	45
7/15[a]	0	0	29	13	5	1	48
7/16	4	1	45	0	3	0	53
7/17	3	11	6	8	5	2	35
7/18	1	5	3	5	11	0	25
7/19	1	8	5	4	6	0	24
7/20[a]	2	6	9	5	7	1	30
7/21	3	4	12	6	7	0	32
7/22	0	0	11	0	0	1	12
7/23[a]	0	0	29	25	1	1	56
7/24[a]	3	0	5	22	1	1	32
7/25	1	4	4	25	1	1	36
7/26	0	2	0	0	0	0	2
7/27	0	0	8	4	8	1	21
7/28[a]	1	14	7	15	11	1	49
7/29[a]	1	6	19	12	18	1	57
7/30[a]	1	6	19	12	18	1	57
7/31	0	0	34	0	3	0	37
8/1	3	4	15	21	40	2	85
Total	51	112	329	271	194	31	988
Percent	5	11	33	27	20	3	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A6.–Estimated chum salmon catch per unit of effort (CPUE) by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	2.4	4.7	0.8	0.0	7.9
7/2	0.0	0.0	3.2	5.7	12.5	0.0	21.4
7/3	0.0	8.1	0.0	0.0	0.8	0.0	8.9
7/4	3.1	2.2	3.9	0.8	0.8	0.0	10.8
7/5	6.9	6.2	0.8	1.6	0.0	0.8	16.3
7/6	5.9	2.2	0.8	0.0	0.0	0.0	8.9
7/7	0.8	5.2	0.0	17.6	13.9	11.1	48.6
7/8	2.0	2.4	0.8	0.0	0.0	0.0	5.2
7/9	1.6	1.6	1.6	9.3	3.4	0.0	17.5
7/10	0.0	0.8	0.0	0.0	0.0	0.0	0.8
7/11	0.0	0.8	2.8	2.1	0.8	0.0	6.5
7/12	0.0	0.0	18.3	5.8	0.0	0.0	24.1
7/13	0.0	0.8	5.2	1.5	0.0	0.0	7.5
7/14[a]	0.0	0.0	8.5	12.5	4.3	1.5	26.8
7/15[a]	0.0	0.0	18.6	7.1	3.3	0.5	29.5
7/16	3.2	0.8	29.0	0.0	2.4	0.0	35.4
7/17	2.3	7.4	4.7	6.1	2.9	1.6	25.0
7/18	0.8	3.8	2.1	3.6	7.9	0.0	18.2
7/19	0.7	4.8	3.4	2.6	4.1	0.0	15.6
7/20[a]	1.5	3.9	5.3	3.1	4.5	0.4	18.7
7/21	2.3	2.9	7.2	3.6	4.9	0.0	20.9
7/22	0.0	0.0	6.3	0.0	0.0	0.8	7.1
7/23[a]	0.0	0.0	16.3	11.0	0.2	0.5	28.0
7/24[a]	2.4	0.0	3.4	9.9	0.2	0.5	16.4
7/25	0.6	3.0	3.0	14.4	0.7	0.6	22.3
7/26	0.0	1.6	0.0	0.0	0.0	0.0	1.6
7/27	0.0	0.0	4.9	2.6	5.0	0.8	13.3
7/28[a]	0.8	8.7	4.7	10.3	6.3	0.8	31.6
7/29[a]	0.9	3.7	11.8	7.0	9.8	0.7	33.9
7/30[a]	0.9	3.7	11.8	7.0	9.8	0.7	33.9
7/31	0	0	23.2	0	2.2	0	25.4
8/1	2	2.7	7.7	10.8	20.7	1.5	45.4
Total	39	77	212	161	122	23	633
Percent	6	12	33	25	19	4	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A7.–Summary of coho salmon fishing effort, daily and cumulative catch, and daily and cumulative catch per unit of effort (CPUE), Upper Cook Inlet offshore test fish project, 2006.

	Number	Mean Fishing	CATCH		CPUE	
Date	of Stations	Time (min)	Daily	Cum	Daily	Cum
7/1	6	226.5	1	1	1	1
7/2	6	221.0	15	16	12	13
7/3	6	230.5	11	27	8	20
7/4	6	231.0	9	36	7	27
7/5	6	224.0	16	52	13	40
7/6	6	223.0	27	79	20	60
7/7	6	239.0	63	142	45	105
7/8	6	229.0	15	157	12	117
7/9	6	225.5	27	184	21	138
7/10	6	218.6	2	186	2	140
7/11	6	235.5	49	235	35	175
7/12	6	241.0	52	287	36	211
7/13	6	229.0	32	319	24	235
7/14	4[a]	254.8	98	417	60	295
7/15	2[a]	247.5	61	478	39	334
7/16	6	230.0	17	495	12	346
7/17	6	252.0	25	520	18	364
7/18	6	235.0	51	571	37	401
7/19	6	262.0	114	685	75	476
7/20	0[a]	0.0	89	774	58	534
7/21	6	260.0	63	837	40	574
7/22	6	249.0	46	883	31	604
7/23	4[a]	225.5	104	987	54	658
7/24	4[a]	187.5	83	1,070	46	705
7/25	6	256.5	49	1,119	32	737
7/26	6	212.5	5	1,124	4	741
7/27	6	250.0	81	1,205	49	790
7/28	5[a]	213.5	136	1,341	89	879
7/29	0[a]	0.0	82	1,423	49	928
7/30	0[a]	0.0	82	1,505	49	977
7/31	6	239.0	17	1,522	11	988
8/1	6	303.5	91	1,613	49	1,037

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A8.–Estimated coho salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	0	1	0	0	1.0
7/2	0	0	1	2	12	0	15.0
7/3	0	10	0	0	1	0	11.0
7/4	0	4	2	0	0	3	9.0
7/5	5	5	0	6	0	0	16.0
7/6	5	20	1	1	0	0	27.0
7/7	0	16	12	17	9	9	63.0
7/8	1	1	7	4	2	0	15.0
7/9	2	1	3	10	11	0	27.0
7/10	0	0	0	1	1	0	2.0
7/11	0	1	12	36	0	0	49.0
7/12	0	0	22	25	5	0	52.0
7/13	0	0	14	16	1	1	32.0
7/14[a]	3	1	31	35	27	1	98.0
7/15[a]	5	1	22	18	14	1	61.0
7/16	0	4	12	1	0	0	17.0
7/17	0	14	2	3	5	1	25.0
7/18	0	1	13	21	15	1	51.0
7/19	0	15	29	44	25	1	114.0
7/20[a]	1	14	31	28	14	1	89.0
7/21	1	12	33	12	3	2	63.0
7/22	1	2	22	16	4	1	46.0
7/23[a]	1	1	43	53	3	3	104.0
7/24[a]	0	8	17	52	3	3	83.0
7/25	2	2	16	15	6	8	49.0
7/26	0	0	5	0	0	0	5.0
7/27	0	1	20	23	36	1	81.0
7/28[a]	0	54	30	20	21	11	136.0
7/29[a]	1	20	26	18	13	4	82.0
7/30[a]	1	20	26	18	13	4	82.0
7/31	0	0	13	4	0	0	17.0
8/1	2	6	34	29	18	2	91.0
Total	31	234	499	529	262	58	1,613
Percent	2	15	31	33	16	4	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A9.–Estimated coho salmon catch per unit of effort (CPUE) by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	0.0	0.8	0.0	0.0	0.8
7/2	0.0	0.0	0.8	1.6	9.3	0.0	11.7
7/3	0.0	6.7	0.0	0.0	0.8	0.0	7.5
7/4	0.0	3.0	1.6	0.0	0.0	2.4	7.0
7/5	3.8	3.9	0.0	4.8	0.0	0.0	12.5
7/6	3.7	14.6	0.8	0.8	0.0	0.0	19.9
7/7	0.0	11.8	9.0	11.1	6.6	6.7	45.2
7/8	0.7	0.8	5.6	3.2	1.6	0.0	11.9
7/9	1.6	0.8	2.4	7.1	9.4	0.0	21.3
7/10	0.0	0.0	0.0	0.8	0.8	0.0	1.6
7/11	0.0	0.8	8.5	25.7	0.0	0.0	35.0
7/12	0.0	0.0	14.3	18.1	3.9	0.0	36.3
7/13	0.0	0.0	10.4	12.0	0.8	0.8	24.0
7/14[a]	1.8	0.8	20.2	17.5	19.3	0.5	60.1
7/15[a]	3.7	0.8	13.9	10.4	9.6	0.5	38.9
7/16	0.0	3.1	7.7	0.8	0.0	0.0	11.6
7/17	0.0	10.6	1.6	2.3	2.9	0.8	18.2
7/18	0.0	0.8	9.3	15.2	10.8	0.8	36.9
7/19	0.0	9.0	20.0	28.4	17.2	0.8	75.4
7/20[a]	0.4	8.9	19.9	17.8	9.7	0.8	57.5
7/21	0.8	8.8	19.8	7.1	2.1	1.6	40.2
7/22	0.7	1.6	12.6	11.7	3.1	0.8	30.5
7/23[a]	0.8	0.8	24.1	23.4	2.5	2.4	54.0
7/24[a]	0.0	6.5	11.5	23.5	2.5	2.4	46.4
7/25	1.2	1.5	12.0	8.6	4.4	4.6	32.3
7/26	0.0	0.0	4.2	0.0	0.0	0.0	4.2
7/27	0.0	0.8	10.2	15.0	22.1	0.8	48.9
7/28[a]	0.0	33.4	20.0	13.8	12.9	8.5	88.6
7/29[a]	0.4	12.3	15.3	10.3	7.4	3.3	49.0
7/30[a]	0.4	12.3	15.3	10.3	7.4	3.3	49.0
7/31	0	0	8.9	2.5	0	0	11.4
8/1	1.4	4.1	17.4	14.9	9.3	1.5	48.6
Total	21	159	317	320	176	43	1,036
Percent	2	15	31	31	17	4	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A10.–Summary of Chinook salmon fishing effort, daily and cumulative catch, and daily and cumulative catch per unit of effort (CPUE), Upper Cook Inlet offshore test fish project, 2006.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	226.5	0	0	0	0
7/2	6	221.0	0	0	0	0
7/3	6	230.5	1	1	1	1
7/4	6	231.0	2	3	2	2
7/5	6	224.0	0	3	0	2
7/6	6	223.0	0	3	0	2
7/7	6	239.0	1	4	1	3
7/8	6	229.0	0	4	0	3
7/9	6	225.5	1	5	1	4
7/10	6	218.6	0	5	0	4
7/11	6	235.5	1	6	1	5
7/12	6	241.0	1	7	1	5
7/13	6	229.0	0	7	0	5
7/14	4[a]	254.8	0	7	0	5
7/15	2[a]	247.5	1	8	1	6
7/16	6	230.0	0	8	0	6
7/17	6	252.0	0	8	0	6
7/18	6	235.0	0	8	0	6
7/19	6	262.0	0	8	0	6
7/20	0[a]	0.0	0	8	0	6
7/21	6	260.0	0	8	0	6
7/22	6	249.0	1	9	1	7
7/23	4[a]	225.5	0	9	0	7
7/24	4[a]	187.5	1	10	0	7
7/25	6	256.5	0	10	0	7
7/26	6	212.5	0	10	0	7
7/27	6	250.0	1	11	1	8
7/28	5[a]	213.5	0	11	0	8
7/29	0[a]	0.0	0	11	0	8
7/30	0[a]	0.0	0	11	0	8
7/31	6	239.0	0	11	0	8
8/1	6	303.5	1	12	1	8

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A11.–Estimated Chinook salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	0	0	0	0	0.0
7/2	0	0	0	0	0	0	0.0
7/3	0	1	0	0	0	0	1.0
7/4	0	0	0	2	0	0	2.0
7/5	0	0	0	0	0	0	0.0
7/6	0	0	0	0	0	0	0.0
7/7	0	0	1	0	0	0	1.0
7/8	0	0	0	0	0	0	0.0
7/9	0	1	0	0	0	0	1.0
7/10	0	0	0	0	0	0	0.0
7/11	0	0	0	1	0	0	1.0
7/12	0	0	0	1	0	0	1.0
7/13	0	0	0	0	0	0	0.0
7/14[a]	0	0	0	0	0	0	0.0
7/15[a]	0	1	0	0	0	0	1.0
7/16	0	0	0	0	0	0	0.0
7/17	0	0	0	0	0	0	0.0
7/18	0	0	0	0	0	0	0.0
7/19	0	0	0	0	0	0	0.0
7/20[a]	0	0	0	0	0	0	0.0
7/21	0	0	0	0	0	0	0.0
7/22	0	0	0	1	0	0	1.0
7/23[a]	0	0	0	0	0	0	0.0
7/24[a]	0	0	0	1	0	0	1.0
7/25	0	0	0	0	0	0	0.0
7/26	0	0	0	0	0	0	0.0
7/27	0	0	0	1	0	0	1.0
7/28[a]	0	0	0	0	0	0	0.0
7/29[a]	0	0	0	0	0	0	0.0
7/30[a]	0	0	0	0	0	0	0.0
7/31	0	0	0	0	0	0	0.0
8/1	0	0	1	0	0	0	1.0
Total	0	3	2	7	0	0	12
Percent	0	25	17	58	0	0	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A12.–Estimated Chinook salmon catch per unit of effort (CPUE) by date and station, Upper Cook Inlet offshore test fish project, 2006.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/3	0.0	0.7	0.0	0.0	0.0	0.0	0.7
7/4	0.0	0.0	0.0	1.5	0.0	0.0	1.5
7/5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/7	0.0	0.0	0.7	0.0	0.0	0.0	0.7
7/8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9	0.0	0.8	0.0	0.0	0.0	0.0	0.8
7/10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/11	0.0	0.0	0.0	0.7	0.0	0.0	0.7
7/12	0.0	0.0	0.0	0.7	0.0	0.0	0.7
7/13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/14[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/15[a]	0.0	0.8	0.0	0.0	0.0	0.0	0.8
7/16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/19	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/22	0.0	0.0	0.0	0.7	0.0	0.0	0.7
7/23[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/24[a]	0.0	0.0	0.0	0.4	0.0	0.0	0.4
7/25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/27	0.0	0.0	0.0	0.6	0.0	0.0	0.6
7/28[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/29[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/30[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/1	0.0	0.0	0.5	0.0	0.0	0.0	0.5
Total	0	2	1	5	0	0	8.1
Percent	0	28	15	57	0	0	100

[a] Not all stations fished due to weather; the data for missing stations was interpolated.

Appendix A13.–Entry pattern of sockeye salmon into Upper Cook Inlet, Alaska, 2006 estimated from daily catch per unit of effort (CPUE) measured at the latitude of Anchor Point.

Day	Date	Input y	Estimated y	Residual	Change in Input Y	Change in Estimated Y
8	1-Jul	0.0051	0.0461	-0.0410		
9	2-Jul	0.0111	0.0522	-0.0411	0.0060	0.0061
10	3-Jul	0.0297	0.0591	-0.0294	0.0185	0.0069
11	4-Jul	0.0425	0.0668	-0.0243	0.0129	0.0077
12	5-Jul	0.0541	0.0754	-0.0214	0.0115	0.0086
13	6-Jul	0.0700	0.0851	-0.0151	0.0159	0.0096
14	7-Jul	0.0917	0.0958	-0.0041	0.0217	0.0108
15	8-Jul	0.1181	0.1078	0.0103	0.0264	0.0120
16	9-Jul	0.1340	0.1210	0.0130	0.0159	0.0132
17	10-Jul	0.1406	0.1356	0.0049	0.0066	0.0146
18	11-Jul	0.1599	0.1517	0.0082	0.0194	0.0161
19	12-Jul	0.1783	0.1693	0.0089	0.0183	0.0176
20	13-Jul	0.1960	0.1885	0.0075	0.0178	0.0192
21	14-Jul	0.2204	0.2094	0.0111	0.0244	0.0208
22	15-Jul	0.2429	0.2319	0.0110	0.0225	0.0225
23	16-Jul	0.2544	0.2560	-0.0016	0.0114	0.0241
24	17-Jul	0.3012	0.2817	0.0195	0.0468	0.0257
25	18-Jul	0.3231	0.3089	0.0142	0.0219	0.0272
26	19-Jul	0.3475	0.3375	0.0100	0.0245	0.0286
27	20-Jul	0.3731	0.3673	0.0057	0.0255	0.0298
28	21-Jul	0.3996	0.3982	0.0014	0.0265	0.0309
29	22-Jul	0.4226	0.4300	-0.0073	0.0230	0.0317
30	23-Jul	0.4590	0.4623	-0.0033	0.0364	0.0323
31	24-Jul	0.4979	0.4949	0.0030	0.0389	0.0326
32	25-Jul	0.5406	0.5276	0.0129	0.0426	0.0327
33	26-Jul	0.5418	0.5601	-0.0183	0.0012	0.0324
34	27-Jul	0.5825	0.5920	-0.0095	0.0407	0.0319
35	28-Jul	0.6071	0.6232	-0.0161	0.0246	0.0312
36	29-Jul	0.6432	0.6534	-0.0102	0.0361	0.0302
37	30-Jul	0.6793	0.6824	-0.0031	0.0361	0.0290
38	31-Jul	0.6893	0.7100	-0.0207	0.0101	0.0277
39	1-Aug	0.7655	0.7362	0.0293	0.0762	0.0262

Appendix A14.–Chemical and physical observations made in Upper Cook Inlet, Alaska during the 2006 offshore test fish project.

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
1-Jul	4	7	9.1	4	north	ebb	34.7	24	9.0
	5	7	9.4	1	northwest	ebb	32.6	35	5.0
	6	8	9.9	4	northwest	ebb	31.8	45	4.0
	6.5	9	9.8	3	north	ebb	30.7	41	3.0
	7	14	9.2	2	northwest	low	29.8	45	4.0
	8	12	9.6	1	northwest	flood	30.1	28	1.5
2-Jul	4	12	8.6	1	northwest	ebb	32.1	24	11.0
	5	12	8.7	2	north	flood	32.4	33	9.5
	6	9	9.0	5	north	flood	32.2	48	8.0
	6.5	10	9.9	5	north	flood	29.7	43	3.0
	7	11	9.8	3	northwest	flood	29.1	46	3.0
	8	10	9.3	4	northwest	flood	29.6	31	3.0
3-Jul	4	9	8.9	8	southwest	flood	32.0	24	9.0
	5	10	10.2	11	southwest	flood	30.1	33	3.0
	6	10	10.1	15	southwest	ebb	29.9	48	3.5
	6.5	10	9.8	16	southwest	ebb	30.1	43	3.0
	7	10	9.7	13	south	ebb	29.7	45	3.0
	8	10	10.0	16	south	flood	29.5	31	3.0
4-Jul	4	10	10.0	9	south	flood	30.4	24	5.5
	5	10	10.0	8	southwest	low	30.2	33	3.5
	6	11	10.2	8	south	low	29.4	48	3.5
	6.5	10	10.3	8	south	low	28.9	43	3.5
	7	10	10.0	8	south	low	28.8	45	2.5
	8	10	9.4	10	south	ebb	29.4	30	2.5
5-Jul	4	10	10.4	10	south	flood	29.4	25	4.0
	5	10	10.2	11	south	flood	29.8	37	4.0
	6	10	10.4	10	south	flood	29.3	48	4.5
	6.5	10	10.3	9	south	flood	29.2	43	3.0
	7	10	10.2	11	south	flood	28.9	45	3.5
	8	10	9.9	9	south	flood	29.0	31	3.5
6-Jul	4	13	9.6	1	south	flood	31.0	25	8.0
	5	14	11.0	2	southeast	flood	29.0	37	4.0
	6	12	10.8	3	south	flood	28.3	46	3.1
	6.5	10	10.7	5	south	ebb	28.0	43	3.0
	7	10	10.6	6	southwest	ebb	27.6	45	3.0
	8	7	9.8	5	southeast	ebb	28.7	31	4.0

-continued-

Appendix A14.–Page 2 of 6.

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
7-Jul	4	12	12.2	5	south	ebb	28.5	25	3.0
	5	13	12.2	6	south	ebb	28.2	37	3.5
	6	11	11.2	10	south	ebb	28.0	46	3.0
	6.5	11	11.0	11	south	ebb	27.8	43	3.0
	7	10	11.1	15	south	flood	27.2	45	4.0
	8	10	10.1	13	south	flood	28.5	31	4.0
8-Jul	4	12	9.9	4	southeast	flood	30.8	25	7.0
	5	11	10.7	6	southeast	flood	29.2	33	4.0
	6	11	10.8	7	southwest	ebb	28.1	46	4.0
	6.5	10	10.8	12	southwest	ebb	27.8	43	3.5
	7	10	10.0	10	southwest	ebb	28.9	45	4.0
	8	10	9.8	7	southwest	ebb	29.1	31	4.0
9-Jul	4	11	9.9	4	south	ebb	30.6	25	8.0
	5	12	11.4	6	south	flood	28.4	37	5.0
	6	13	11.3	2	south	flood	28.4	25	5.0
	6.5	13	10.7	3	east	flood	28.7	43	4.0
	7	12	10.6	4	south	flood	28.2	45	4.5
	8	13	9.8	6	east	flood	28.8	31	4.5
10-Jul	6	12	10.7	2	southwest	ebb	31.0	46	3.0
	6.5	11	10.2	6	southwest	ebb	31.4	43	3.0
	7	12	10.2	6	southwest	ebb	29.3	45	3.5
	8	12	10.3	5	south	ebb	29.6	31	4.0
	4[a]	11	9.9	2	east	flood	28.9	25	9.5
	5[a]	11	9.6	3	southwest	ebb	28.4	37	4.0
11-Jul	4	10	9.9	10	northwest	ebb	31.2	25	8.0
	5	11	9.7	7	northwest	ebb	31.3	37	5.5
	6	11	9.5	6	northwest	ebb	30.8	46	3.5
	6.5	11	9.8	7	southwest	ebb	30.1	41	2.5
	7	12	9.8	6	southwest	flood	29.4	45	2.0
	8	13	10.3	8	southwest	flood	28.6	48	2.5
12-Jul	4	11	10.1	4	southeast	ebb	31.1	22	6.0
	5	11	9.5	7	south	ebb	31.3	35	6.0
	6	11	9.8	10	south	ebb	30.4	47	3.5
	6.5	10	9.7	10	southeast	ebb	30.1	42	3.0
	7	11	9.8	9	south	flood	29.3	46	2.0
	8	11	9.9	5	south	flood	28.5	32	3.0

-continued-

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
13-Jul	4	15	10.2	5	southeast	ebb	31.4	23	7.0
	5	11	9.9	6	southeast	ebb	31.5	32	6.0
	6	12	9.9	5	south	ebb	30.7	47	3.5
	6.5	12	10.1	4	south	flood	30.1	43	1.5
	7	15	10.1	1	south	flood	29.3	44	-
	8	14	11.1	9	south	flood	28.5	29	-
14-Jul	4	11	10.4	13	southeast	ebb	31.3	23	-
	5	11	10.4	12	southeast	ebb	31.6	32	5.0
	6	11	10.5	6	southeast	ebb	30.4	47	3.0
	6.5	12	9.8	10	southwest	ebb	30.5	43	-
	7	12	9.9	8	southwest	flood	29.6	44	-
	8	12	10.5	9	southwest	flood	28.5	29	-
15-Jul	4	10	9.4	13	south	flood	31.7	25	8.0
	5	10	9.9	16	south	flood	31.4	35	7.0
	6	12	10.6	4	south	flood	30.3	46	-
	6.5	12	10.2	9	south	flood	30.1	41	-
	7	12	10.4	9	south	flood	29.4	44	-
	8	13	10.6	6	south	flood	28.6	30	-
16-Jul	4	15	10.8	3	south	flood	31.4	30	1.5
	5	12	10.8	6	south	ebb	31.2	45	2.5
	6	12	10.6	8	south	ebb	30.1	39	3.0
	6.5	12	10.7	2	south	high	29.7	46	3.5
	7	12	10.1	2	south	high	29.2	33	6.5
	8	11	9.6	3	south	high	28.7	23	9.0
17-Jul	4	12	10.9	5	northwest	flood	28.6	26	2.0
	5	10	10.5	3	northeast	flood	31.4	46	3.0
	6	11	10.2	5	northeast	high	31.3	43	4.0
	6.5	11	10.0	3	northeast	high	30.4	49	6.0
	7	12	9.8	2	northeast	high	29.4	36	9.0
	8	11	9.8	2	north	ebb	28.2	23	9.0
18-Jul	4	12	11.0	5	north	ebb	31.0	29	3.0
	5	11	11.0	6	north	ebb	31.0	46	3.0
	6	12	11.0	6	north	ebb	30.9	40	3.5
	6.5	11	9.9	7	north	flood	29.7	49	7.0
	7	11	9.8	5	north	flood	29.5	37	8.0
	8	11	9.7	4	north	flood	29.4	24	7.0

-continued-

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
19-Jul	4	12	11.5	10	northeast	ebb	31.4	29	2.0
	5	11	11.3	12	northeast	ebb	31.1	46	2.0
	6	11	10.8	15	northeast	flood	30.6	40	2.5
	6.5	11	10.4	16	northeast	flood	29.9	49	2.5
	7	11	9.7	13	northeast	flood	29.0	37	-
	8	11	9.7	14	northeast	ebb	28.3	23	-
20-Jul	4	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
	6.5	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-
21-Jul	4	12	10.1	9	northeast	ebb	31.2	23	7.0
	5	12	10.9	10	northeast	ebb	30.1	37	6.0
	6	12	10.3	11	north	flood	30.3	49	4.0
	6.5	12	11.1	8	north	flood	29.1	40	3.0
	7	11	13.2	8	northeast	ebb	29.2	49	2.0
	8	12	11.3	6	northeast	ebb	28.9	29	3.0
22-Jul	4	12	9.6	1	northeast	flood	31.4	26	-
	5	12	11.3	11	northwest	flood	31.1	37	-
	6	11	10.6	10	northwest	ebb	29.8	49	-
	6.5	12	11.4	12	northwest	flood	28.0	40	-
	7	12	11.2	13	northwest	ebb	28.6	49	-
	8	12	11.2	4	northwest	ebb	28.7	29	-
23-Jul	4	11	9.9	10	north	ebb	31.4	26	7.0
	5	11	10.1	15	north	ebb	30.7	37	6.0
	6	12	10.6	16	north	ebb	30.1	49	-
	6.5	12	10.5	16	north	flood	29.8	40	-
	7	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-
24-Jul	4	10	9.3	4	south	high	31.4	23	-
	5	11	9.2	7	south	high	31.5	37	-
	6	10	9.5	7	south	flood	31.3	49	-
	6.5	12	10.4	12	northwest	flood	30.0	40	-
	7	-	-	-	-	-		-	-
	8	-	-	-	-	-		-	-

-continued-

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
25-Jul	4	11	9.8	7	northwest	flood	31.3	23	8.5
	5	11	9.7	11	northwest	flood	31.3	37	9.0
	6	11	9.8	9	northwest	flood	31.0	49	7.5
	6.5	11	9.8	8	northwest	flood	31.0	40	8.0
	7	12	11.2	10	northwest	flood	29.0	46	3.0
	8	12	10.9	9	northwest	flood	29.0	29	3.0
26-Jul	4	11	9.8	3	southeast	ebb	31.2	23	10.0
	5	11	9.9	6	southeast	ebb	30.8	37	5.0
	6	14	10.9	0	south	ebb	28.6	49	4.0
	6.5	12	11.1	2	south	ebb	28.3	40	3.0
	7	13	10.7	1	southwest	high	29.1	46	3.0
	8	15	10.8	1	southwest	high	28.6	29	3.0
27-Jul	4	11	9.6	4	south	ebb	30.8	23	10.0
	5	11	10.3	5	south	ebb	30.6	37	6.0
	6	12	10.5	4	south	ebb	30.3	49	7.0
	6.5	13	6.8	3	south	flood	29.9	36	3.5
	7	13	11.7	4	south	flood	28.8	46	4.0
	8	13	11.3	3	south	flood	29.1	29	3.0
28-Jul	4	12	10.0	8	southwest	flood	31.3	23	5.0
	5	11	11.2	13	southwest	ebb	29.4	32	3.0
	6	11	11.3	13	southwest	ebb	28.7	47	3.5
	6.5	11	10.7	13	southwest	flood	29.6	43	3.0
	7	-	-	-	-	-	-	-	-
	8	11	10.5	11	southwest	flood	29.6	29	3.0
29-Jul	4	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
	6.5	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-
30-Jul	4	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
	6.5	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-

-continued-

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
31-Jul	4	12	10.3	3	south	ebb	31.0	23	10.0
31-Jul	5	12	10.8	4	south	ebb	30.1	35	6.0
31-Jul	6	12	11.9	5	southeast	ebb	28.4	47	3.0
31-Jul	6.5	13	11.1	5	southeast	ebb	29.5	43	5.0
31-Jul	7	13	12.1	4	southeast	flood	28.6	46	4.5
31-Jul	8	13	11.5	4	southeast	flood	28.8	27	4.0
1-Aug	4	11	10.5	9	southeast	ebb	30.6	24	-
1-Aug	5	11	10.9	13	southeast	ebb	30.0	33	-
1-Aug	6	12	11.4	12	southeast	ebb	29.1	47	-
1-Aug	6.5	11	11.2	15	southeast	flood	29.1	44	-
1-Aug	7	13	11.3	11	southeast	flood	29.0	46	-
1-Aug	8	12	11.5	6	southeast	flood	28.4	32	-

[a] Strong winds prohibited the test boat from fishing these stations.

Appendix A15.–Yearly mean values of physical observations made during the conduct of the 1996-2006 offshore test fish project.

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
4	1997	13.7	9.5	8.9	SE	31.6	24.6	6.2
	1998	12.5	9.7	9.7	SE	31.0	24.4	9.5
	1999	13.1	9.6	10.6	SE	31.4	24.3	7.6
	2000	13.8	9.7	10.0	SE	31.5	23.5	10.0
	2001	12.9	9.8	11.1	SE	31.5	23.6	8.4
	2002	12.6	9.5	12.6	S	31.4	23.6	8.1
	2003	14.1	10.6	12.0	S	31.2	23.4	8.3
	2004	10.7	9.6	7.1	E	31.3	23.8	7.9
	2005	12.9	10.9	6.2	S	31.0	24.5	7.4
	2006	11.1	9.9	6.0	SE	31.1	23.9	7.7
Avg		12.7	9.9	9.4	SE	31.3	24.0	8.1
5	1997	13.7	9.9	10.1	SE	31.3	36.8	5.2
	1998	12.8	9.8	9.8	SE	31.1	35.2	8.5
	1999	13.4	10.0	12.9	SE	30.6	38.9	6.2
	2000	13.5	10.1	11.8	SE	30.7	35.9	7.1
	2001	12.9	10.1	11.2	SE	31.0	35.5	6.9
	2002	12.8	9.7	13.9	S	30.9	35.8	6.3
	2003	14.0	11.0	13.3	SE	30.6	35.7	6.3
	2004	10.7	9.9	7.2	SE	30.7	34.7	7.1
	2005	13.1	11.1	5.9	S	30.6	36.3	6.5
	2006	11.1	10.2	7.6	S	31.6	35.4	5.6
Avg		12.8	10.2	10.4	SE	30.8	36.0	6.6

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
6.5	1997	13.9	10.7	9.4	E	29.6	43.4	3.2
	1998	12.7	10.5	7.7	SE	29.5	43.3	3.5
	1999	13.4	10.5	13.0	SE	29.7	43.2	3.5
	2000	13.6	10.8	13.0	S	29.7	42.9	3.7
	2001	12.8	11.1	11.8	S	29.4	42.7	4.0
	2002	12.6	10.4	13.7	S	30.0	42.6	3.3
	2003	14.4	11.7	14.9	S	29.1	41.3	4.1
	2004	10.7	10.8	10.1	SE	29.4	41.6	3.6
	2005	13.2	12.2	7.4	S	28.7	42.8	4.2
	2006	11.2	10.3	8.5	SE	29.9	41.6	3.4
Avg		12.9	10.9	10.9	S	29.5	42.5	3.6
7	1997	14.0	10.9	10.3	SE	30.2	44.8	2.9
	1998	12.3	10.7	8.4	SE	29.1	44.3	3.0
	1999	13.3	10.6	13.0	S	29.5	42.7	2.9
	2000	13.1	10.9	13.6	S	29.4	43.3	3.0
	2001	13.1	11.4	9.9	SE	29.0	43.6	3.5
	2002	12.4	10.4	12.4	SE	29.9	44.0	2.8
	2003	14.3	11.6	13.0	S	29.0	44.3	3.6
	2004	10.6	11.0	9.7	SE	28.8	44.7	2.7
	2005	12.9	12.3	7.6	S	28.3	44.8	3.6
	2006	10.8	9.9	6.8	S	29.5	42.4	3.1
Avg		12.7	11.0	10.5	S	29.3	43.9	3.1

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)	Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
6	1997	13.8	10.5	11.1	SE	30.8	45.9	3.7	8	1997	13.7	11.1	9.6	SE	30.1	30.1	2.6
	1998	12.4	10.3	10.9	S	30.0	46.1	4.7		1998	12.5	10.7	9.1	S	29.1	29.3	2.8
	1999	13.5	10.3	12.5	SE	29.8	44.4	4.3		1999	13.6	10.5	11.8	SE	30.0	25.9	2.6
	2000	13.5	10.6	11.1	SE	29.9	45.4	4.9		2000	13.2	11.0	14.0	S	29.5	29.1	2.6
	2001	12.8	10.7	10.7	S	30.5	46.2	5.2		2001	12.8	11.3	9.5	SE	29.0	28.9	3.1
	2002	12.8	10.1	13.4	S	30.4	45.1	4.2		2002	12.1	10.3	11.8	SE	30.0	29.4	2.4
	2003	14.7	11.5	12.9	S	29.5	46.4	4.9		2003	13.7	11.2	11.6	SE	28.1	28.9	3.1
	2004	10.6	10.3	8.0	SE	30.1	46.6	4.6		2004	10.8	11.0	9.1	SE	29.3	28.7	2.4
	2005	12.8	11.6	8.0	S	29.4	45.8	4.7		2005	12.8	12.1	7.7	S	28.5	29.8	3.3
	2006	12.8	11.6	8.0	S	29.0	45.8	4.7		2006	11.8	10.5	6.7	S	28.9	30.4	3.0
Avg		13.0	10.8	10.7	S	29.9	45.8	4.6	Avg		12.7	11.0	10.1	SE	29.2	29.0	2.8

Appendix A16.–Yearly mean values for selected chemical and physical variables collected during conduct of the offshore test fish project, 1979-2006.

Year	Air Temp. (c)	Water Temp. (c)	Wind Vel. (knots)	Salinity (ppt)	Secchi (m)
1979	12.4	12.2	5.9	25.0	5.7
1980	12.4	10.0	8.2	24.8	4.2
1981	13.4	11.0	10.1	23.1	4.1
1982	12.0	8.5	9.0	20.3	5.0
1983	14.9	10.9	9.4	20.6	4.7
1984	13.5	10.8	9.1	14.3	5.3
1985	10.8	8.2	9.2	28.0	5.5
1986	10.6	9.1	8.2	-	5.4
1987	12.6	10.1	4.1	28.4	5.1
1988	14.2	9.1	8.9	30.2	4.7
1989	13.1	10.0	4.4	27.7	4.7
1990	12.3	11.4	8.5	21.3	4.6
1991	10.9	9.9	6.6	13.1	4.1
1992	12.0	11.1	5.4	28.4	4.3
1993	13.5	10.5	6.9	26.2	5.0
1994	13.0	10.0	9.3	29.0	6.0
1995	13.1	9.5	7.9	26.5	4.6
1996	12.6	10.0	9.1	30.8	4.7
1997	13.8	10.5	10.0	30.6	4.0
1998	12.5	10.3	8.3	30.0	5.4
1999	13.4	10.3	12.4	30.2	4.5
2000	13.5	10.5	12.2	30.1	5.2
2001	12.9	10.7	10.7	30.1	5.2
2002	12.5	10.1	13.0	30.4	4.5
2003	14.2	11.3	12.9	29.6	5.0
2004	10.7	10.4	8.5	30.0	4.7
2005	13.0	11.7	7.1	29.4	5.0
1992-2005 Avg	12.9	10.5	9.6	29.4	4.9
2006	11.3	10.3	7.2	29.9	4.6